NOVEMBER, 1934.

GENERAL PHYSICS.

ADSORPTION.

4366. Exchange Adsorption and Adsorption Indicators. I. M. Kolthoff. *Kolloid Zeits.* 68. *pp.* 190–201, *Aug.*, 1934.—A summary.
F. J. W.

See also Abstracts 4396, 4452, 4747.

ATOMIC AND MOLECULAR STRUCTURE.

4367. Nuclear Energy Levels and the Model of a Potential Hole. H. Margenau. *Phys. Rev.* 46. *pp.* 613–615, *Oct.* 1, 1934.—Part I contains the solution of the problem of a particle for which the potential energy $V(r)$ is a simple rectangular hole of finite depth, such a model being of interest in connection with the spacing of nuclear energy levels. Formulæ are given by which a numerical determination of energies can be carried out for any assumed depth of the hole. In Part II the results are extended to finite holes of different shape, and an argument is presented which proves the inadequacy of any such model to explain the arrangement of α-ray levels in Ra C′. AUTHOR.

4368. Height of the Potential Boundary of the Atomic Nucleus. V. Kravcov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 235–237, *Aug.* 1, 1934. *In German.*—By extrapolation from data got by Pollard's method of measurement for the light elements the height of the potential boundary for high atomic numbers can be obtained with an accuracy of about 10 %. The results obtained by recent investigators for the radioactive elements are mentioned. The value of the effective radius of the atomic nucleus varies very little over the whole periodic system. Thus its value for the light nuclei is according to Pollard $5\cdot9 \times 10^{-13}$, and for Th it is $9\cdot5 \times 10^{-13}$. J. J. S.

4369. Constitution of Metallic Sodium. Part II. E. Wigner and F. Seitz. *Phys. Rev.* 46. *pp.* 509–524, *Sept.* 15, 1934.—In the first part of this paper a completely self-consistent solution of Fock's equations for the sodium lattice is carried through indirectly, this being the approximation in which one-electron functions are employed. The question of the correlations between electrons with parallel spin is investigated quantitatively and the Fermi " zero-point energy " is calculated using the proper effective field. The results show that the electrons behave almost exactly as if they were entirely free, the binding energy being 9 k.cal. and the lattice constant 4·86 Å, as compared with the observed values 26·9 k.cal. and 4·23 Å. To complete the picture, the correlations between electrons with anti-parallel spins are investigated in the latter part, since these are not included in the Fock picture. A general discussion of this question is presented and a quantitative treatment of its effect is made which yields a new binding energy of 23·2 k.cal. and a lattice constant of 4·75 Å. The source of the remaining discrepancy is discussed. [For Part I see Abstract 2673 (1933).] AUTHORS.

4370. Disintegration of Sodium. A. König. *Zeits. f. Physik,* 90. 3–4. *pp.* 197–208, *Aug.* 10, 1934.—By using a very thin sheet of sodium produced by a molecular-ray method it has been found possible to detect four groups of protons emitted from sodium when bombarded with α-particles. Two of the groups have a resonance character and the energy of the group having the greatest range agrees with the difference between the mass defects of Na^{23} and Mg^{26}. J. E. R. C.

4371. Disintegration of Diplons. J. Chadwick and M. Goldberger. *Nature,* 134. *pp.* 237–238, *Aug.* 18, 1934.—It is to be expected that an effect corresponding to the ordinary photoelectric effect should occur when γ-radiation falls upon nuclei having a sufficiently small mass defect. Experiments are described in which γ-radiation from ThC″ is allowed to fall upon diplogen contained in the chamber of a valve counter. A number of disintegrations which are attributed to the reaction :— ${}_1D^2 + h\nu \rightarrow {}_1H^1 + {}_0n^1$ are observed. The effect does not seem to be produced in any marked degree by γ-rays of $1 \cdot 8 \times 10^6$ electron volts and the mass of the neutron based upon these data is given as 1·0080 with extreme errors of ± 0·0005. The measured cross-section for disintegration of the ThC″ γ-ray is about 10^{-28} sq. cm., which is in fair agreement with the calculated value. The probability of a process which is the reverse of the above is also discussed and found to be much smaller. J. E. R. C.

4372. Resonance Phenomena in Artificial Disintegration. H. Pose. *Phys. Zeits.* 35. *pp.* 633–636, *Aug.* 15, 1934.—Other experimenters having failed to observe the proton groups reported by the author the experiments have been repeated under more precise experimental conditions. These confirm his earlier experiments and it is stated definitely that the proton emissions from Al, F, N, and Na each contain at least two resonance groups while there is possibly one resonance group in the emission from B. A discussion of the method of entry of the disintegrating particle into the nucleus is also given. J. E. R. C.

4373. Disintegration of Nitrogen. H. Stegman. *Phys. Zeits.* 35. *pp.* 636–637, *Aug.* 15, 1934.—By bombarding dicyandiamide and examining the protons emitted in a backward direction, three groups of protons have been observed. With an α-particle range of 3·7 cm. these have ranges 56, 81·5, and 101·5 mm. Results obtained by varying the energy of the incident α-particle indicate that the smallest and largest groups arise from α-particles which have entered through resonance levels. J. E. R. C.

4374. Proton Emission from Boron and Phosphorus under Bombardment by High-Energy α-Rays. R. F. Paton. *Zeits. f. Physik,* 90. 9–10. *pp.* 586–596, *Sept.* 6, 1934.—The groups of protons emitted when B and P are subjected to bombardment by α-particles from ThC′ are determined with the aid of a Geiger counter. The following table shows the results for protons emitted at 80° to the direction of the incident α-particles which themselves have a range of 8·6 cm. :

Group.	1	2	3	4
P Range 80° (cm.)	72	50	31	—
Energy Balance (e.v.)	0	$1 \cdot 47 \times 10^6$	$-2 \cdot 96 \times 10^6$	—
B Range 80° (cm.)	95	52	37	25·5
Energy Balance (e.v.)	$3 \cdot 1 \times 10^6$	$0 \cdot 35 \times 10^6$	$-0 \cdot 78 \times 10^6$	$-1 \cdot 86 \times 10^6$

Results were also obtained for α-particles of 7·6, 6·1 and 5·2 cm. range. With B the yield of protons is almost independent of the energy of the α-particles ; with P, while the yield is at least as great as with B when α-particles of maximum energy are used, there is a marked decrease with lower energy α-particles. F. C. C.

4375. Artificial Disintegration. W. D. Harkins and D. M. Gans. *Phys. Rev.* 46. *pp.* 397–404, *Sept.* 1, 1934.—A mathematical analysis of non-capture nuclear disintegration is given. By an examination of available experimental evidence it is concluded that disintegrations produced by neutron bombardment are accompanied by capture of the neutron and that, in fact, non-capture disintegrations have not been observed. J. E. R. C.

4376. Artificial Radioactivity. A. Drigo. *N. Cimento,* 11. *pp.* 482–494, *July,* 1934.—A summary of recent work in this field of research. J. J. S.

4377. Radioactive Phosphorus and Its β-Ray Spectrum. J. Ambrosen. *Zeits. f. Physik,* 91. 1–2. *pp.* 43–48, *Sept.* 17, 1934.—Fermi found that the induced radioactivity produced by neutron bombardment is always associated with chemical transformation, the atomic number of the element changes by one or two with evolution of either an α-particle or a proton. It may be assumed that both changes occur in general, but that the life of one of the active products is sometimes vanishingly small. Before the energy distribution of the β-rays from the active product can be found it is necessary—in order to eliminate absorption effects by the non-active mass—to separate out the active product. This is possible in the cases: $^{32}_{16}\mathrm{S} + ^{1}_{0}n \rightarrow ^{32}_{15}\mathrm{P} + ^{1}_{1}\mathrm{H}$, and $^{35}_{17}\mathrm{Cl} + ^{1}_{0}n \rightarrow ^{32}_{15}\mathrm{P} + ^{4}_{2}\mathrm{He}$, for the life of the active P is very long. After separation the active products were studied as regards (*a*) decay times—with a Geiger counter; (*b*) β-ray spectrum—with a Wilson chamber; and (*c*) absorption of the β-rays through Al. The "half life" of the P from S was 17·5 ± 1·1 days and the same value was given by the Cl. product. The results from the β-ray tracks in a Wilson chamber placed in a magnetic field of 1330 gauss are given diagrammatically and in a table. The distribution is in general agreement in the two cases. The maximum energy is 2×10^6 e-V. This does not lie anywhere near the Sargent curve and the author shows that this is also the case with other " artificial " elements so far studied. It is considered that there is no existing theory covering the facts. J. E.

4378. Heavy Hydrogen and Heavy Water. G. Bottecchia. *N. Cimento,* 11. *pp.* 390–409, *June,* 1934.—Gives a chronological sketch of the discovery and subsequent researches on heavy hydrogen and heavy water, with full Bibliography and a table of the physical constants of these substances. W. S. S.

4379. Deuterium Content of Natural Butane. R. D. Snow and H. L. Johnston. *Science,* 80. *pp.* 210–211, *Aug.* 31, 1934.—Using Lewis and Macdonald's buoyancy-balance method to compare the densities of ordinary water and of water formed in the combustion of natural butane (98 % *n*-butane) from Burbank, Oklahoma, the authors find $\Delta \mathrm{T} = 0{\cdot}032 \pm {\cdot}003^\circ$ C. Assuming for ordinary water a D/H ratio of 1/5000 and after correction for the probable O^{18} content of the oxygen used, this Δ T implies that the hydrogen of this butane contains 30 % more deuterium than ordinary hydrogen, a result agreeing with independent measurements on kerosene from the same district. L. V. C.

4380. Concentration of H^2 in Hydrogen. S. Frisch and V. Černiajev. *Comptes Rendus de l'Acad des Sciences, U.R.S.S.* 3. *pp.* 245–248, *Aug.* 1, 1934. *In English.*—Using the electrolytic cell method a concentration of about 1·2 % H^2 in the residual water was obtained.

After further concentration the vapour of the sample was introduced into a discharge tube and the intensity of the H^2_β line found to be 3 % as compared with that of the H^1_β line, indicating a concentration increase to 3 %. By diffusion of the hydrogen obtained from this sample (by reaction with sodium) through a hot palladium tube, a final increase in concentration of H^2 to 5 % was obtained. N. M. B.

4381. Purification of H^2 by Diffusion. H. Harmsen, G. Hertz and W. Schütze. *Zeits. f. Physik.* 90. 11–12. *pp.* 703–711, *Sept.* 17, 1934.—The efficiency of the apparatus previously described [see Abstract 2676 (1933)] for the separation of gaseous isotope mixtures is increased by doubling the number of separating elements and by the use of larger pumps in part of the system. By a single application of the process the Ne^{22} may now be extracted in almost pure condition from normal neon. H^2 can be prepared by the apparatus to a considerable degree of purity. Starting with hydrogen containing 1 % of H^2, 1 c.c. of spectroscopically pure H^2 at atmospheric pressure can be obtained in 8 hr. J. E. K.

4382. Heavy Hydrogen. L. Farkas. *Naturwiss.* 22. *pp.* 614–623, *Sept.* 14; 640–646, *Sept.* 21, *and pp.* 658–662, *Sept.* 28, 1934.—Literature relating to H^2 is critically reviewed. Reference is made to 173 papers on the subject. J. S. G. T.

4383. Heavy Hydrogen. Part III. Electrolytic Separation of the Hydrogen Isotopes. A. and L. Farkas. *Roy. Soc., Proc.* 146*A*. *pp.* 623–629, *Oct.* 1, 1934.—It is shown that when in the electrolysis of a mixture of light and heavy water a preferential liberation of light hydrogen takes place, the gas evolved may reach equilibrium with the water corresponding to the reaction $H_2O + HD \rightleftharpoons HOD + H_2$, the equilibrium constant of this reaction being about 3·8 at room-temperature. It is pointed out that the position of this equilibrium is an important factor in the electrolytic separation of the hydrogen isotopes. [For Parts I and II see Abstract 1775 (1934)]. AUTHORS.

4384. Heavy Hydrogen. Part IV. Hydrogenation and Exchange Reaction of Ethylene with Heavy Hydrogen. A. and L. Farkas, and E. K. Rideal. *Roy. Soc., Proc.* 146*A*. *pp.* 630–639, *Oct.* 1, 1934.—An examination of the interaction of ethylene and light and heavy hydrogen at a catalytically active nickel surface has revealed the fact that two reactions are involved; an exchange reaction which may be written $C_2H_4 + HD \rightleftharpoons C_2H_3D + H_2$ and the more usual addition reaction $C_2H_4 + HD \rightleftharpoons C_2H_5D$. The steric factors and the temperature coefficients of these two reactions are not identical. By examining the rate of hydrogenation simultaneously with the rate of para-ortho hydrogen conversion some light is thrown on the mechanism of hydrogenation reactions. [See preceding Abstract.] AUTHORS.

4385. Normal Vibrations of Molecules with Tetrahedral Symmetry. N. S. N. Nath. *Indian Journ. Phys.* 8. 6. *pp.* 581–592, *June*, 1934.—A formula is set up for the potential energy function of molecules of the type AB_4 having tetrahedral symmetry, the constants of the function being based purely on chemical concepts of the structure of the molecules. The formula contains terms due to the primary valence bonds, the directed valence bonds, the forces between corner atoms and the " intra-valence " forces (" perturbation " energy). Expressions are derived for the frequencies of the normal modes of vibration in terms of the molecular binding constants and for the form of the " intra-valence " energy function. The various force-constants are calculated for the molecules

CCl_4, $SiCl_4$, $TiCl_4$, $GeCl_4$, $SnCl_4$ and CH_4 and compared with experimental values. Perfect agreement between the theoretical and experimental values is only obtained when the " intra-valence " energy function is taken into account. The " intra-valence " energy affects all but the totally symmetrical modes of vibration. J. E. K.

4386. Photographic Method for the Study of Mechanical Models of Vibrating Molecules. D. H. Andrews and J. W. Murray. *J. Chem. Phys.* 2. *pp.* 634–636, *Oct.*, 1934.—The difficulty of ascertaining accurately by visual observation the vibrations of mechanical models has been overcome by a photographic method of observation. The optical arrangement is such that when the model is executing a characteristic mode of vibration in phase with an agitating bar, propelled by an electric motor, the intensity of light is four times greater at one extreme of the phase than at the other. A camera is set to take a time exposure of the vibrating model; photographs are reproduced for a linear triatomic model, and models of NH_3 and CH_4. The vibrations observed for NH_3 and CH_4 are discussed in relation to existing Raman effect data. W. R. A.

4387. Molecular Structure as Determined by a New Electron Diffraction Method. Part I. Experimental. Part II. Halogen-Carbon Bond Distance in Some Simple Benzene Derivatives. H. de Laszlo. *Roy. Soc., Proc.* 146*A*. *pp.* 672–700, *Oct.* 1, 1934.—A detailed account is given of a simplified and perfected technique of obtaining photographic records of the scattering of fast electron beams by vapours and gases. Interference patterns, with many more maxima than was previously possible, can be obtained with the vapour of any substance which will vaporise *in vacuo* up to 1000° C. without decomposition, whilst a simplified method of calculating the theoretical scattering curves, with which the experimental results are compared, can be employed. Results with the vapours of hexachlor- and hexabrombenzene, *sym*- tribrom- and triiodobenzene, and *p*-dibrom- and diiodobenzene are recorded. They agree with theoretical scattering curves based on a model where benzene is a regular flat haxagonal ring with C-C equal to $1 \cdot 41$ Å. The following halogen-carbon distances are found: $C–Cl = 1 \cdot 69$ Å, $C–Br = 1 \cdot 88$ Å, $C–I = 2 \cdot 05$ Å, with a possible error of $\pm 0 \cdot 01$ Å. These distances appear to remain constant and to be independent of the number of similar atoms substituted at the same time in the benzene ring, and all the atoms lie in the plane of the ring. The distances are about $0 \cdot 06$ Å less than those generally accepted for aliphatic compounds. C. B. A.

4388. Molecular Weights of Hydrocarbon Oils. M. R. Fenske, W. B. McCluer and M. R. Cannon. *Indust. & Engin. Chem.* 26. *pp.* 976–980, *Sept.*, 1934.—Average molecular weights of complex high-boiling hydrocarbon mixtures have been obtained by a method based on heats of vaporisation. This permits an independent check on the cyroscopic method of molecular weight determinations. Using six different oils, the greatest difference between the two methods was found to be 7 %. The average molecular weights of fourteen different hydrocarbon oil fractions have been determined satisfactorily by the method involving heats of vaporisation. These data have been correlated on the bases of viscosity index and $37 \cdot 8°$ C. (100° F.) Saybolt viscosity by the equation: $\text{Mol. wt.} = 240 + 32{,}310 \log_{10}(100° \text{ F. viscosity}/28 \cdot 0)/(305 - \text{viscosity index})$. AUTHORS.

See also Abstracts **4453, 4488, 4494, 4554, 4572, 4573, 4589, 4591, 4627, 4685, 4687, 4700.**

COLLOIDS.

4389. Limits of the Applicability of Ultrafiltration to the Detection of the Colloidal State. B. Erschler. *Kolloid Zeits.* 68. *pp.* 289–298, *Sept.*, 1934.—During filtration through collodion membranes, crystalloid substances may be largely retained, such retention differing markedly in character for electrolytes and non-electrolytes. With the latter, the retention is independent of the concentration of the solution and is in general small in amount (2 or 3 per cent). With electrolytes, however, the retention depends greatly on the concentration of the solution; for dilute solutions it is high and may reach 30 or 50 per cent for 0·005 *M* solutions, whereas at concentrations of 1 *M* it falls to 2 or 3 per cent. The amount retained by the membrane is the greater if the ion of the electrolyte having a similar charge to the membrane has a high valency, and the ion having an opposite charge a low valency. These results are discussed. T. H. P.

4390. Kinetics of Slow Coagulation. S. Ghosh. *Kolloid Zeits.* 68. *pp.* 316–324, *Sept.*, 1934.—Current views regarding the nature of the processes constituting slow coagulation are discussed. Smoluchowski's equation, modified for the case of slow coagulation, expresses the process only if the concentration of the coagulating electrolyte is high. If such concentration is low, the velocity of discharge of the colloidal particles assumes predominant influence. With slow coagulation, the S-shaped curves expressing the relation between the number of aggregating particles and the time are observed only for definite concentrations of the electrolyte. This characteristic shape is more marked with lyophile than with lyophobe sols. With low concentrations of electrolyte, Smoluchowski's equation may be applicable during the early stages of the coagulation but later fails to be applicable. T. H. P.

4391. Flow-Birefringence of Cadmium Glycerophosphate Solutions. G. van Iterson, Jr. *K. Akad. Amsterdam, Proc.* 37. 7. *pp.* 367–376, 1934.—Description and illustrations of the phenomena of streaming double refraction of aqueous solutions of this salt. A. S C. L.

4392. Mechanical Properties of Disperse Systems and Surface Layers. Part II. B. Derjaguin and E. Obuchov. *Kolloid Zeits.* 68. *pp.* 243–246. *Sept.*, 1934.—This paper investigates the elastic properties and dispersity of foams, and a theory of elasticity is developed [see Abstract 4346 (1933)] wherein only the surface tension of the boundary films of the separate cells is considered, the particular elastic properties of the films themselves being neglected. The theory is tested by experiment, for which purpose an apparatus has been constructed which enables the simultaneous measurement of the thrust modulus μ of a foam and the excess pressure Δp within the cells. Experiments with foams from a 0·02 % aqueous solution of saponin have completely confirmed the theory derived for foam elasticity, and show that $\mu/\Delta p$ is very near the theoretical value of 0·4. For foams from 0·1 % saponin solutions much greater values of $\mu/\Delta p$ have been established, which indicate the appearance of appreciable elasticity in the surface layers of the cell walls. This shows that the elasticity of the superficial adsorption layers increases abruptly on approach to saturation. An exact theory of foam elasticity must consider the elasticity of the surface layers of the cell walls. The manometric measurement of the pressure increase during the crushing of foams serves as the simplest and most accurate method for the determination of the specific surface and degree of dispersity of a foam. H. H. Ho.

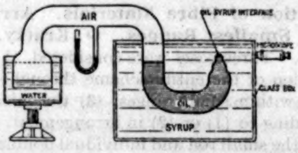
4393. Rhythmic Precipitation of Silver Chromate in Cellophane. J. Ratelade. *Comptes Rendus,* 199. *pp.* 555–557, *Sept.* 3, 1934.—Cellophane was soaked in solution of $K_2Cr_2O_7$, dried under tension, and suspended vertically in a closed vessel. The lower portion was immersed in solution of $AgNO_3$, and the upper part of the vessel was filled with air or a non-aqueous liquid, e.g. hexane, heptane or vaseline oil. The rhythmic lines of $AgCrO_4$ then formed are much closed together, though Veil's square root law is obeyed [see Abstract 1027 (1931)], while the height to which the $AgNO_3$ solution ascends is lower, when the non-aqueous liquid occupies the upper portion of the vessel, than when air does so; in this latter case the whole strip becomes moist [see Abstract 2127 (1933)]. C. A. S.

4394. Deformation of Fibre Materials. Arrangement of Micelles in Films in Smallest Ranges. O. Kratky. *Kolloid Zeits.* 68. 347–350, *Sept.,* 1934.—Three cases were considered, (1) where the arrangement is a reproduction of the entire scheme throughout the material, (2) there is parallelism within small ranges, (3) the micelles are in bundles which may be according to (1) or (2) in arrangement. It is shown that if the quotient Q from the small rod and individual double refraction increases for increasing stretching of the films then case (1) exists, but if it remains constant then (2) and (3) prevail. Wachtler has shown that nitrocellulose film, if investigated in the extension range from 0 to 80 per cent gives a constant value for Q giving within small ranges an arrangement as in (2) or (3). The X-ray data are compared with macroscopic findings for the density of hydrocellulose films and confirm the results. Mechanical analogies are given illustrating the same idea. S. G. B.

4395. Reversal of Emulsion Types. C. L. Wilson. *Chem. Soc. J. pp.* 1360–1361, *Sept.,* 1934.—Benzene-in-water emulsions are sometimes reversed when the emulsifying agent—sodium oleate—contains free oleic acid. A. S. C. L.

4396. Adherence and Coalescence in Emulsions. W. C. M. Lewis. *Faraday Soc., Trans.* 30. *pp.* 958–967, *Oct.,* 1934.—On the basis that the critical potential represents the limiting condition for adherence between emulsion droplets which possess the *average* kinetic energy of translation it is calculated that the minimal area of adherence is of the order 10^{-13} cm.^{2} Considerations are advanced which indicate that the Powis estimate of 30 mV for the true critical potential is too high. The subsequent change of adherence to coalescence is considered in the light of the decrease in interfacial energy over the area of adherence and it is shown that surface energy is probably adequate to account for the removal of the water molecules which separate two adhering oil droplets. AUTHOR.

4397. Formation of Emulsions in Definable Fields of Flow. G. I. Taylor. *Roy. Soc., Proc.* 146*A. pp.* 501–523, *Oct.* 1, 1934.—The distortion of a drop of one fluid by the viscous forces associated with certain mathematically definable fields of flow of another fluid which surrounds it is discussed, and an expression is obtained for small distortions from the spherical drop form occurring at low speeds. If L is the greatest and B the least diameter of the drop, $(L-B)/(L+B) = F$ approximately, where F is a non-dimensional quantity which is proportional to the speed of flow and involves the surface tension, viscosity, and the radius of the drop. Two forms of apparatus for producing in golden syrup two definable fields of flow have been constructed, and their effects on drops of various oily liquids observed and registered photographically. At low speeds of flow the effects agree with theoretical expectations, but at higher speeds the effect produced by the flow varies greatly with variation in the ratio, μ^1/μ, between the viscosities of the drop and syrup. For $\mu^1/\mu = 0\cdot0003$ the drop elongated almost indefinitely, whilst for the values $0\cdot5$ and 1, the drop burst at $F = 1\cdot4$ and $0\cdot5$ respectively. For $\mu^1/\mu = 20$ the drop burst at $F = 0\cdot3$ in one type of field but not in the other. The difficulty of bursting drops of viscous fluids by a disruptive field of flow in a surrounding field of much lower viscosity is qualitatively in accordance with a theory of drops in a laminar shearing field of flow when F and μ^1/μ are both large. According to this theory, $(L - B)/(L + B) = 5\,\mu/4\,\mu^1$. The viscosities were measured by a torsion method, and surface tensions by means of the apparatus shown in the figure. The syrup-oil interface was at the end of a very short length of capillary tube of $0\cdot37$ mm. bore. The syrup was in an open glass-walled box, and the interface could be observed through a microscope. The oil was in a **U**-tube, and the pressure of the air over the air-oil surface (of large area) could be varied and measured. The air-pressure was first adjusted until the syrup-oil interface appeared flat in the microscope (the oil wetted the glass) and then measured. This pressure was then increased till it attained its maximum steady value when the interface was hemispherical. The difference between the two air-pressures is $2\,T/a$, a being the radius of the hemisphere. T. H. P.



4398. Sedimentation Formulæ. H. Wadell. *Physics*, 5. *pp.* 281–291, *Oct.*, 1934.—This paper presents some new methods of computing the sedimentation radius. The methods are founded on a curve for spheres, experimentally determined and constructed on the basis of the coefficient of resistance as a function of Reynolds number. When the validity of Stokes' law ceases, the sedimentation radius obtained by Stokes' formula is graphically corrected. The amount of deviation of Stokes' law from experimental data of higher Reynolds numbers has been statistically determined. Some new formulæ for computing the resistance and the radius of a sphere of a given terminal settling velocity are presented.

AUTHOR.

4399. Sedimentation Equilibrium in Colloidal Suspensions. S. Levine. *Roy. Soc., Proc.* 146*A*. *pp.* 597–623, *Oct.* 1, 1934.—An expression for the distribution law for the sedimentation equilibrium in colloidal suspensions is derived. Using the Boltzmann distribution law a term involving the energy of a single particle, associated with its charge and surrounding " ionic atmosphere," is introduced. This term is evaluated as a power series in the concentration of particles by using the methods of statistical mechanics, assuming the electrostatic energy E_{12} associated with two colloidal particles to be known. To obtain E_{12} the differential equation used by Debye and Hückel to find the potential about an ion is solved for two particles. The potential and the charge distribution of the ions about the two particles are thereby derived and integration of the energy density gives E_{12}. The results indicate departure from Perrin's law varying, according to the charges on the particles and the concentration of electrolyte present, from $n = 1 \cdot 6 \times 10^{13}$ to $n = 4 \cdot 0 \times 10^{14}$ with corresponding limiting concentrations lying between $n = 2 \cdot 1 \times 10^{14}$ and $n = 5 \cdot 5 \times 10^{15}$. The expression for the distribution is also applied to sedimentation in the centrifuge. AUTHOR.

4400. Self-Recording Coagulometer with New Constant Torque Drive. S. B. Stoker. *Journ. Sci. Instruments*, 11. *pp.* 315–319, *Oct.*, 1934.—An instrument which makes the use of the blood coagulometer of Cannon and Mendenhall possible and easy for bedside work is described. A clockwork motor revolves a smoked drum on which the record is made and, at the same time, allows the wire plunger used to dip into the shed blood at half-minute intervals. The exact coagulation time, from the moment the blood is withdrawn to its coagulation point, is thus recorded on a smoked surface. A special piece of gearing has been used with the object of procuring a perfectly even tracing on the drum. The whole forms an easily portable instrument. AUTHOR.

4401. Electrodialyser. P. D. Watson and P. N. Peter. *Rev. Sci. Instruments*, 5. *pp.* 362–365, *Oct.*, 1934.—The construction of a small electrodialyser suitable for the removal of salts from colloids of high salt content is described. The distinctive features of the apparatus are the use of permanent diaphragms of alundum or porcelain for the dialysing chamber and the regulation of the H-ion concentration therein by means of a siphon device which transfers all or part of the kathode effluent to the anode compartment. The results of several experiments are presented which indicate a decrease of about 80 % in the salt content of protein solutions during a period of 6 hr. AUTHORS.

See also Abstract 4414.

CRYSTAL STRUCTURE AND PROPERTIES.

4402. Disperse Structure of Real Crystal Systems, and Initial Temperature of "Grey-Glow." D. Balarew and N. Karabaschew. *Kolloid Zeits.* 68. *pp.* 261–266, *Sept.*, 1934.—This initial temperature is in structural connection with the system as a growth-conglomerate. Two factors enter: firstly the presence of comparatively mobile ions, and secondly the ageing of the system. [See also Abstract 897 (1934).] F. I. G. R.

4403. Mosaic Structure of Real Crystals, and the Theory of Heterogeneous Equilibrium. D. Balarew. *Kolloid Zeits.* 68. *pp.* 266–271, *Sept.*, 1934.—It is demonstrated experimentally that the theory of heterogeneous equilibrium needs extension to take account of surface changes within the crystalline mass, and the presence of thermodynamic equilibrium for a disperse structure. F. I. G. R.

4404. Theory of Polarisation-Energy in Cubic Lattices. T. Neugebauer. *Zeits. f. Physik*, 90. 9–10. *pp.* 693–697, *Sept.* 6, 1934.—The polarisation energy does not vanish, on account of overlaying of the electronic "cloud." A method of calculation is given, using the numerical process of Fermi. [See also Abstract 3477 (1934).] F. I. G. R.

4405. Photoelectric Conductivity and Energy Levels of Electrons in Crystals. P. Tartakowsky. *Zeits. f. Physik*, 90. 7–8. *pp.* 504–511, *Sept.* 4, 1934.—An attempt is made to set up a scheme of electronic energy levels for NaCl crystal on the basis of the experimental findings of different workers. [See following Abstract.] L. A. W.

4406. Absorption of Light in NaCl Crystals under Electron Bombardment. L. Reverdatto. *Zeits. f. Physik*, 90. 7–8. *pp.* 512–519, *Sept.* 4, 1934.—The absorption of light in NaCl crystals is investigated during simultaneous bombardment of the crystal surface with electrons. It is found that the bombardment causes the appearance of an absorption band with its maximum at 472 mμ. The mechanism of the absorption is discussed in terms of the electronic energy levels of the crystal. [See preceding and following Abstracts.] L. A. W.

4407. Electronic Energy Levels in a Finite Crystal. A. Sokolow. *Zeits. f. Physik*, 90. 7–8. *pp.* 520–541, *Sept.* 4, 1934.—Wave-mechanics calculations are given for all the possible proper values and proper functions for an electron in an infinite one-dimensional crystal model, also in an ideal crystal (model of Penney) and in a crystal with irregularity (*Lockerstelle*). The results obtained are applied to the explanation of some phenomena connected with photoconductivity. [See preceding Abstract.] L. A. W.

4408. Structure of a Complex Cu-Si Compound. F. R. Morral and A. Westgren. *Arkiv f. Kem. Min. och Geologi, Stockholm*, 11B. No. 37. [6 *pp.*], 1934. *In English.*—The compound of Cu and Si corresponding to 21 atomic per cent Si is found, by means of X-ray powder photographs, to be $Cu_{15}Si_4$. The structure is based on a body-centred cubic lattice and the space-group is T_d^6. Atomic positions are given, based partly on known atomic dimensions and partly on considerations of intensity. J. T.

4409. Transitions in Cu-Au Alloy. W. S. Gorsky. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 69–81, 1934. *In English.*—A brief review is given of the atomic structure of a Cu-Au alloy containing 50 atomic % Cu as determined by several workers, including the author [see Abstract 3162 (1928).] It is shown that the ratio of the tetragonal to dygonal parameter of the lattice depends on the temperature. In the present work this ratio is measured as a function of the annealing period and the velocity of transition of the lattice to the equilibrium state is determined. The change in the ratio of the axes of the lattice causes a strain to be set up which changes the dimensions of the lattice and alters the equilibrium value of the degree of irregularity in the lattice. The alteration in the equilibrium for various temperatures is studied theoretically for the Cu-Au alloy. H. J. H. S.

4410. Segregation of Polonium in Bismuth Crystals. A. B. Focke. *Phys. Rev.* 46. *pp.* 623–628, *Oct.* 1, 1934.—Single crystals of Bi containing Po as an impurity are studied in order to determine the distribution of the Po. Number-distance relations for α-particles emitted normally through cleavage surfaces afford the means of investigation, measurements being made with a Geiger counter. When present in very small concentrations Po is found to be segregated into small regions which have nearly regular spacings when viewed in several directions. These average spacings, (0·54 ± 0·03)μ for planes parallel to the (111) plane and (0·90 ± 0·1)μ for planes parallel to the (111) plane, are unaffected by the speed of growth of the Bi crystal and by subsequent heat treatment. The addition of Te suppresses alternate layers parallel to the (111) plane and removes all evidence of layers parallel to the (111) plane. AUTHOR.

4411. X-Ray Study of the Effect of Heat on the Structure of Sputtered Films of Gold. S. R. Swamy. *Phys. Soc., Proc.* 46. *pp.* 739–744, *Nov.* 1, 1934.—Sputtered films of gold different thicknesses were heated to various temperatures up to 800° C. and their Debye-Scherrer photographs were obtained after each stage of heating. The photographs showed on examination that on being heated the gold crystals in the film oriented themselves in such a way that their 111 planes were parallel to the surface of deposition. The crystals were also found to grow when the film was heated. The degree of orientation as well as the size of the crystals, obtained from the photographs, were found to depend on both the thickness of the film and the temperature to which it was heated. [See Abstract 3766 (1931).] AUTHOR.

4412. X-Ray Investigation of the Disperse Structure of Graphites. W. S. Wesselowski and K. W. Wassiliew. *Zeits. f. Krist.* 89. 2. *pp.* 156–174, *Oct.*, 1934.—The elements forming disperse structures are classified as (I) crystallites; (II) aggregates of crystallites forming somatoids or micelles; and (III) texture, the comparatively coarse structure. Crystallites are characterised by their (1) intrinsic properties, (*a*) composition, (*b*) degree of dispersion, (*c*) shape; (2) mutual relations, (*a*) orientation, (*b*) intervening empty space, (*c*) mode of union; and (3) resulting structure as a whole, (*a*) batotropy or regular spacial variation, and (*c*) chronotropy, or temporal variation, *e.g.* ageing. Varieties of graphite occurring naturally or artificially (coke, pitch, soot, in iron, etc.) are then classified as a result of chemical, optical, and X-ray observations of the authors and others. [See Abstracts 1849 and 4781 (1932).] C. A. S.

4413. Structure of Copper Sulphate Pentahydrate. C. A. Beevers and H. Lipson. *Roy. Soc., Proc.* 146*A*. *pp.* 570–582, *Oct.* 1, 1934. —In $CuSO_4 \cdot 5H_2O$ the Cu atoms lie on the special positions (000) and $(\frac{1}{2}\frac{1}{2}0)$ and the S upon the general position (0·01 0·29 0·64). Four of the H_2O molecules are arranged in squares around the Cu atoms and two O atoms make with these approximate octahedra. The fifth H_2O is not coordinated, but is in contact with two O atoms and two H_2O molecules. All the H_2O molecules show two O bonds each, in accordance with recent ideas. AUTHORS.

4414. X-Ray Diagram of Ring-Fibre Structure and Orientation of Micelles in Films. I. Sakurada and K. Hutino. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 512. *pp.* 193–210, *Aug.*, 1934. *In German.*—It is shown theoretically and confirmed experimentally that a configuration with a simple ring-fibre structure exhibits a complete Debye-Scherrer circle when penetrated by rays perpendicular to the axis of symmetry. The intensity is not, however, distributed regularly along the circle, being greatest at the equator, so that the whole diagram appears like an ordinary fibre diagram. Unstretched films of cellulose nitrate and acetate possess a ring-fibre structure in which the crystallites lie with a crystal axis, corresponding with the fibre axis of ordinary fibre structure, parallel to the plane of the film. A simple classification of the crystallite arrangement is proposed. Where the crystallites are quite without arrangement, they have free rotatability about three arbitrary rectangular coordinate axes. If rotation about one, two or three of the axes is lost, orientations of the first, second or third order arise. If a film is stretched in the *y* direction, rotation about the *x*-axis is first lost. With further expansion, a crystallite assumes a position in which its definite crystal plane agrees with

x-y and rotation about the y-axis is lost. Only with much greater stretching is rotation about the z-axis lost, the crystallites becoming parallel to the direction of stretching. T. H. P.

4415. X-Ray Diffraction Studies of Enamel and Dentine. W. F. Bale, H. C. Hodge and S. L. Warren. *Am. J. of Roentgenology & Radium Therapy*, 33. *pp.* 369–376, *Sept.*, 1934.—By means of X-ray diffraction the constitution and molecular arrangement of the inorganic matter of enamel or dentine of teeth has been studied and the diffraction rings are discussed in detail. The dentine from a single tooth whether normal, transparent, or opaque, gives rise to identical appearances, but the diffraction rings vary for different teeth. The constitution of the inorganic salts approximates to that of apatite and there is no evidence of any other crystalline material. The mean crystal size is calculated and varies in respect to enamel and dentine. B. J. L.

4416. Anisotropy in Rate of Growth of New Nuclei during Recrystallisation. M. Kornfeld. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 170–174, 1934. *In German.*—In polycrystalline Al which exhibits a texture, an anisotropy in the velocity of growth of new nuclei has been observed at temperatures which lie only scarcely above the recrystallisation threshold. It is shown that the degree of anisotropy depends on the temperature. Photographic illustrations are included. H. H. Ho.

4417. Crystal Separation in Evaporation of Dilute Solutions. H. Flood and L. Tronstad. *Kolloid Zeits.* 68. *pp.* 333–335, *Sept.*, 1934.—The slow evaporation of dilute solutions in glass vessels of spherical form gives rise to discontinuous deposition of the solute in concentric annuli or, in the last stages, in spirals. From experiments with solutions of borax and of dilute alkali the authors reject explanations based on cyclic deposition and super-saturation or on phases of meniscal deposition starting from nuclei. Evaporation most readily occurs in the meniscus; the explanation given thus postulates a greater wetting of the deposit than of the glass walls of the vessel, resulting in a thickening of the meniscus and a steady concentration of the deposit until the level of the liquid has dropped so far that a continuous film is no longer possible, when the process recommences at a lower level. L. V. C.

4418. Electron Conduction and Colour Centres in Fluorspar. E. Mollwo. *Göttingen Nachrichten.* 1. 6. *Fachgruppe* 2. *pp.* 79–89, 1934.—In fluorspar, as in alkali halides, colour centres may be produced by thermal or electric immigration of electrons, the number of colour centres being equal, within the limits of experimental error, to the number of electrons capable of migration as determined by electrical measurement. The colour centres arise from stoichiometric excess of the kation metal, this being several powers of ten higher in fluorspar than in alkali halides. Such excess may be measured by optical methods and, for the higher concentrations, also by density measurements or by chemical analysis. Similar phenomena occur with crystals of strontium chloride. Preliminary observations have been made of the thermal solution of colloids in the colour centres and their migration in an electric field, and of the acceleration of the flocculation of the colour centres by such field. T. H. P.

4419. Photoelectric Method of Determining the Elastic Limit of Rock-Salt. M. N. Podaschewsky. *Zeits. f. Physik*, 91. 1–2. *pp.* 97–104, *Sept.* 19, 1934.—The effect of deformation on the internal photoelectric effect of rock-salt crystals pigmented with X-rays [see Abstract 1376 (1931)] is applied to the determination of the elastic limit at room-temperature.

An arrangement is adopted which permits of the comparison of the elastic limit values obtained by the optical, X-ray and photoelectric methods for one and the same specimen. Deformations due to stretching and bending are investigated. The sensitivity of the photoelectric method is found to be much greater than that of the other methods. Since the mechanism underlying the effects is different in the different methods, the values obtained depend not only upon the individual properties of the specimen but also upon the nature of the method used. It is noted that with increase of sensitivity of method the observed value for the elastic limit falls, approaching zero. L. A. W.

4420. Small-Scale Structure of Surfaces. G. P. Thomson. *Phil. Mag.* 18. *pp.* 640–656, *Oct.*, 1934.—By reflection of electrons at a crystal surface information is obtained regarding the small-scale geometric structure of the surface. Some of the results already obtained are collected together and a detailed examination is given of the conclusions to which electron diffraction experiments can lead. The smoothness and perfection of surfaces are considered, also the effects of various methods of obtaining the surfaces and of various treatments of them. J. T.

See also Abstracts 4394, 4474, 4484, 4597, 4621, 4632, 4689.

DENSITY.

See Abstract 4379.

DIFFUSION AND OSMOSIS.

4421. Automatic Recording Micro-Osmometer for Colloidal Osmotic Pressures. F. Urban. *Rev. Sci. Instruments,* 5. *pp.* 375–377, *Oct.*, 1934.—A chymograph record of colloidal osmotic pressures, at constant volume, was obtained with 1·3 c.c. of solution. The recording and counter-balancing of the colloidal osmotic pressure is automatically performed. The apparatus is comparatively simple, and convenient to use. AUTHOR.

See also Abstracts 4380, 4381, 4421.

ELASTICITY AND PLASTICITY.

4422. Elastic Bending of a Curved Rectangular Bar under Direct Stress. E. Jones and R. J. Cornish. *Phil. Mag.* 18. *pp.* 456–458, *Sept.*, 1934.—The formula usually given in text-books for the above neglects the alteration in the depth of the bar, and a formula is worked out for the relative angular movement of the two ends of a short sector of the bar. G. E. A.

4423. Buckling of Wire under its Own Weight. A. Leon and E. Erlinger. *Ann. d. Physik,* 20. 6. *pp.* 635–645, *Sept.*, 1934.—Phenomena of buckling of wires of iron, steel, copper, aluminium and lead fixed vertically at their lower ends, under the influence of their own weight only. Comparison with the formulæ of A. E. Greenhill. A. D.

4424. Compressibility of Aqueous Solutions. Part II. W. G. Thomas and E. P. Perman. *Roy. Soc., Proc.* 146*A*. *pp.* 641–650, *Oct.* 1, 1934.—Slight improvements and modifications of Perman and Urry's method [see Abstract 2317 (1930)] of measuring the compressibility of solutions are described. Results are given for solutions of KCl, KBr, KI, $CaBr_2$, $SrBr_2$, $BaBr_2$, acetic acid, and formaldehyde. The measurements were made at 30° C. and over the pressure range 0–100 atmospheres excess. In an Appendix, results for solutions of glucose, sucrose, and raffinose, obtained by W. D. Urry, over the same pressure range, are given. The results are discussed with regard to compressibility in equi-molecular solutions, and to the effect upon the solvent of differently constituted solute molecules. AUTHORS.

See also Abstracts 4616, 4760.

HYDRODYNAMICS AND AERODYNAMICS.

4425. Meeting of Forced and Free Streams. C. Agostinelli. *Accad. Sci. Torino, Atti,* 69. 1. *Disp.* 3. *pp.* 436–457, 1934.—Discusses the two-dimensional problem of the meeting of a free stream of liquid and a stream forced to flow between parallel walls. The problem is resolved by using a method due to Boggio, in which the field of motion is represented conformally on the field of velocity vectors of the liquid particles.
A. J. McC.

4426. Stability and Oscillations of Certain Permanent Arrangements of Parallel Vortices. W. B. Morton. *Roy. Irish Acad., Proc.* 42*A*. 2. *pp.* 7–14, 1934.—The stability of the vortex motions discussed in a previous paper [see Abstract 1838 (1934)] is examined. It is found that the triangular arrangement of the vortices is stable when the centre about which it rotates lies within the circumscribed circle ; the arrangement in a rhombus is stable when the acute angle of the rhombus is not smaller than $\cos^{-1}(1/\sqrt{3})$. The former has two proper frequencies of oscillation about steady motion ; the latter has three. The modes of oscillation are examined in detail and expressions derived for the shapes, relative sizes and phase relationships of the elliptic paths described by the vortices round their mean positions in the disturbed motion. J. S. G. T.

4427. Pressure Energy—A Misconception. G. A. van Lear, Jr. *Am. Phys. Teacher,* 2. *pp.* 99–100, *Sept.,* 1934.—Attention is called to two compensating fallacies contained in the derivation of Bernoulli's theorem as it appears in most elementary physics text-books ; namely, the attributing to unit volume of liquid of an amount of energy numerically equal to the pressure, the so-called " pressure-energy," and the assertion or implication that a chosen portion of the liquid has no work done on it as it passes down a flow tube. It is pointed out that consistent use of the concept of " pressure energy " can lead to incorrect results, and the flaw in the arguments by means of which it is usually introduced is indicated. A derivation of Bernoulli's theorem which is not open to these objections, and which is suitable for use in elementary physics classes, is given.
AUTHOR.

4428. Two Designs of Flow-Meter, and a Method of Calibration. G. Barr. *Journ. Sci. Instruments,* 11. *pp.* 321–324, *Oct.,* 1934.—A compact form of capillary-tube flow-meter is obtained by enclosing the capillary in the widened arm of a U-tube manometer. A modification of Beckett's pulsing gas meter is described, in which a stream of gas displaces liquid from an inner to an outer tube ; when a certain pressure-difference is reached, the breaking of a liquid seal allows the gas in the inner tube to be discharged so that the original conditions are restored. The volume discharged per pulse from such a meter was found to be 10 per cent greater at high speeds than at low. Calibration of meters of small capacity is effected by connecting them to a graduated tube that has a soap film across its bore. When the walls of this tube are wet, the film is mobile and stable, so that gas may be collected and measured at a pressure that is almost exactly atmospheric. AUTHOR.

See also Abstracts 4398, 4475, 4476, 4477, 4480.

KINETIC THEORY OF MATTER.

4429. Scattering of Molecular Rays in Gases. Part II. F. Knauer. *Zeits. f. Physik*, 90. 9–10. *pp.* 559–566, *Sept.* 6, 1934.—Employing apparatus previously used [see Abstract 1326 (1933)] the scattering of He rays by Hg vapour was investigated. It was found that rays from slow molecules are scattered to a smaller extent than those from fast molecules, in agreement with classical theory. For scattering angles under 0·9° measurements with H and He rays show that the converse is true. This is shown to be in agreement with wave-mechanical principles. W. R. A.

4430. Linear Problems in Brownian Movement. G. Krutkow. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 5. *pp.* 215–221, *Aug.* 1, 1934. *In German.*—Continues previous work [see Abstract 2316 (1934)]; mathematical developments. A. D.

See also Abstract 4662.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

4431. Wringing of End-Gauges. H. Schmidt. *Zeits. f. Instrumentenk.* 54. *pp.* 309–311, *Sept.*, 1934.—Reference is made to some of the recent work on the " wringing " property of end-gauges, whereby combinations of different lengths may be built up from separate gauges by the simple process of bringing the optically-flat surfaces of the gauges into contact with one another in a suitable manner. The importance of the extremely thin fluid film generally included between the contacted surfaces is discussed, and the conclusion is reached that the wringing property is due to the action of molecular forces. H. B.

4432. Evenness Tester. I. J. Saxl. *Rev. Sci. Instruments*, 5. *pp.* 365–366, *Oct.*, 1934.—Describes a machine for measuring diameters of weaving and knitting yarns and for continuously observing variations of diameter along considerable lengths of such filaments. The instrument is also suitable for determining the sizes of fine wires, tapes or paper strips. The yarn passes from a constant tension device between the edge of a fixed guide plate and a light contact piece which is pivoted and carries a small mirror. Variations of diameter cause small rotations of the pivoted member and produce movements of a spot of light on a screen. With a working distance of about 15 ft. between mirror and screen a magnification of 1600 is obtained by the combined mechanical and optical lever described. Absolute values of diameter or thickness are obtained by calculation from the geometrical circumstances of the system. H. B.

See also Abstract 4753.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

4433. Transformation Theory of Linear Canonical Equations. C. Lanczos. *Ann. d. Physik*, 20. 6. *pp.* 653–688, *Sept.*, 1934.—Transformations of a special group of Hamiltonian canonical equations in which the Hamiltonian function appears as a quadratic form of the variables are discussed. The theory affords a very useful process of successive approximation applicable to the integration of the fundamental equations of mathematical physics. J. S. G. T.

4434. Solution of Boundary Problems in Mathematical Physics. J. Neufeld. *Phil. Mag.* 18. *p.* 624, *Oct.*, 1934.—A correction. [See Abstract 2321 (1934).]

4435. Correlation of Time-Series. J. T. Morrison. *Phil. Mag.* 18. *pp.* 545–553, *Oct.*, 1934.—In studying the correlation of two time-series a preliminary analysis of each by polynomials or by simple harmonic functions allows us (1) to state with precision the characteristics of their long-term trends, (2) to write down at once that portion of their regression coefficient which arises from these trends, (3) to make some estimate of the significance of that coefficient, (4) to deal separately with the correlation of short-term residuals, with or without various degrees of lagging. AUTHOR.

See also Abstract 4445.

MECHANICS, CLASSICAL.

4436. Equations of Motion of a Non-Holonomic Dynamical System. B. S. M. Rao. *Mysore Univ., J.* 7. *pp.* 1–4, *Jan.*, 1933.—By a slight modification of Appell's equations, the author derives a form of Lagrange's equations of motion for a non-holonomic dynamical system without introducing the Lagrangian undetermined multipliers, and such that the number of equations is equal to the number of degrees of freedom. A. J. McC.

4437. Dynamics of Plane Systems. G. Merlo. *Accad. Sci. Torino, Atti*, 69. 1. *Disp.* 3. *pp.* 415–431, 1934.—The author proves that the resultant of the forces of inertia in the plane motion of a lamina always passes through a point—the pole of inertia—characterised by the geometry of the motion and the masses. This result is then applied to some problems on the kinematics of the motion. A. J. McC.

4438. Statistical Ideas of Dynamical Systems. L. Pontrjagin, A. Andronoff and A. Witt. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 1–24, 1934. *In German.*—A dynamical system is considered which is described by n differential equations of the first order, $dx_i/dt = \chi^{(i)}(x_1, x_2, \ldots\ldots x_n)$ where $i = 1, 2, \ldots n$. For given initial conditions these equations determine singularly the relation of the point position of the system in phase space. It is assumed that according to the laws of chance, impulses or disturbances affect the system. Consideration of these follows two lines connected with two problems dealt with in the paper ; (1) the relation of the system under such impulses and especially to construct a theoretical scheme to explain in agreement with experimental conditions, the character of these accidental impulses in the real dynamical system ; and (2) the general theory of motion according to Birkhoff, compensated by probability conditions, and especially from the extent of possible movements to indicate which take place with the greatest probability when the impulses act. It is intended in a later paper to follow this investigation for statical mechanics. R. S. R.

4439. Self-Oscillating Systems Approximating to the Hamiltonian. L. S. Pontrjagin. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 25–28, 1934. *In German.*—Self-oscillating systems are investigated whose differential equations are of the form, $dx/dt = - d\mathrm{H}(x, y)/dy + p\,(x, y, \mu)$; $dy/dt = - d\mathrm{H}\,(x, y)/dx + q\,(x, y, \mu)$, in which μ is small, $p\,(x, y, o) = q\,(x, y, o) = o$; and for $\mu = o$ the exact Hamiltonian equations shall admit of a continuous series of closed integral curves. Then in general for $\mu \neq 0$ a discrete number of closed curves is transformed into a boundary cycle and all others into a spiral. The " energy constant " of the boundary cycle and its stability are investigated. R. S. R.

See also Abstracts 4399, 4459.

MECHANICS, QUANTUM.

4440. Solution of Problems Involving Permutation Degeneracy. R. Serber. *J. Chem. Phys.* 2. *pp.* 697–710, *Oct.*, 1934.—Matrix methods are developed for calculating the energy levels of many-electron systems. By means of the " pure matrix method " the permutation matrices are found for states of various multiplicities arising from configurations of eight or fewer electrons. From these convenient orthogonal representation of the energy matrix is obtained. A systematic procedure is given for a partial factorisation of the secular determinant. The second method, in which explicit representations of the permutations are not required, makes use of algebraic relations satisfied by the permutations. The procedure is illustrated by the four-electron problem, including non-orthogonality corrections, and the interactions between configurations. As illustrative examples the energy levels of all multiplicities are found for the hexagonal (benzene) configuration, eight similar orbits at cube corners, the body-centred cube, and the singlet levels of the tetrahedral (methane) configuration. N. M. B.

4441. Eigenfunctions for Electrons of Heavy Elements. L. Pincherle. *N. Cimento*, 11. *pp.* 372–379, *June*, 1934.—By replacing the Coulombian potential function a/r by a potential of the form $a/(e^{kr} - 1)$, in Schrödinger's equation for electrons with azimuthal quantum number $l = 0$, solutions are obtained for the eigenfunctions of electrons in the X-ray levels of heavy elements. The constant k is so chosen that the potential function approximates to the Thomas-Fermi statistical potential when r equals the mean distance of the electron from the nucleus for the level in question. By an extension of the analysis the case of electrons for which l is not zero, is covered. Using the eigenfunctions computed by this method, values for the relative intensities of X-ray lines of tungsten and silver are derived which agree with the experimental values more closely than calculations assuming hydrogen eigenfunctions. W. S. S.

4442. Wave-Equation Corresponding to a Given Hamiltonian. P. G. Gormley. *Roy. Irish Acad., Proc.* 42A. 1. *pp.* 1–6, 1934.—The wave equation in quantum mechanics is deduced for a Hamiltonian of the form $\mathrm{H} = p^r q^s$, for one which describes a system with n degrees of freedom in classical mechanics, and for one of the form $\mathrm{H} = \sum_r a^r p_r$. N. M. B.

4443. Indeterminacy Principle. F. E. White. *Nat. Acad. Sci., Proc.* 20. *pp.* 525–529, *Sept.*, 1934.—The magnitude of the indeterminacy product is calculated for higher order indeterminacies, using the mean-square deviation. In the case of the third order the average value of the coordinate is zero, while the values for the second and fourth orders are of the same magnitude, corresponding to the value for the harmonic oscillator. Results for the linear oscillator in a uniform field and for the harmonic oscillator are identical. The anharmonic oscillator and the effect of the perturbation are also investigated. N. M. B.

4444. Modified Ritz Method. D. H. Weinstein. *Nat. Acad. Sci., Proc.* 20. *pp.* 529–532, *Sept.*, 1934.—The Ritz variation method of approximating to the lowest energy level and wave function of that level in certain characteristic value problems, applied to a linear combination of *n* independent variables gives an upper bound to the *n*th excited level. The method is modified to give an upper and lower bound to the energy level and this result can be used to give the maximum error from the nearest energy level, and as a method of finding an energy level. N. M. B.

4445. Averages Over Portions of Configuration Space. G. Heller and L. Motz. *Phys. Rev.* 46. *pp.* 502–505, *Sept.* 15, 1934.—The integral $\int_\gamma^\delta R{nl}^2\rho^{\sigma+2}d\rho$ is evaluated where R_{nl} is the radial hydrogen eigenfunction. The results are applied to the calculation of term shifts when the Born-Infeld potential function replaces the Coulomb potential function in the one-electron Schrödinger problem. AUTHORS.

4446. Observations on Hilbert's Independence Theorem and Born's Quantisation of Field Equations. H. Weyl. *Phys. Rev.* 46. *pp.* 505–508, *Sept.* 15, 1934.—Born recently proposed [see Abstract 487 (1934)] a quantisation of the field equations which is based upon Hilbert's independence theorem of the calculus of variations. A formulation as simple and explicit as possible of the independence theorem is here given. The agreement between the principle of variation and the independence theorem, complete in the case of one independent variable and one unknown function, fails in two respects in the case of several variables and functions; the independence theorem specialises the extremal vector field on the one hand and it discards the assumption of integrability on the other hand. A modification of Born's scheme is suggested without which it would be in disagreement with ordinary quantum mechanics even in the one-dimensional case. After the modification, a comparison with Heisenberg-Pauli's quantisation becomes possible under the simplest circumstances. Born's scheme proves to be too narrow. The principal objection is raised that the quantum-mechanical equation should not be of the form: four-dimensional divergence of ψ equals $H\psi$ with a scalar operator of action H, but that it should rather consist of four components stating that differentiation of ψ with respect to the four space-time coordinates is performed by means of the operators: energy and momentum. AUTHOR.

4447. Approximation Treatment for Many-Electron Systems. C. Møller and M. S. Plesset. *Phys. Rev.* 46. *pp.* 618–622, *Oct.* 1, 1934.—A perturbation theory is developed for treating a system of *n* electrons in which the Hartree-Fock solution appears as the zero-order approximation. It is shown by this development that the first order correction for the energy and the charge density of the system is zero. The expression for the second-order correction for the energy greatly simplifies because of the special property of the zero-order solution. It is pointed out that the development of the higher approximation involves only calculations based on a definite one-body problem. AUTHORS.

4448. General Statistical Method for an Assembly of Indistinguishable Particles. G. Allard. *Comptes Rendus*, 199. *pp.* 451–453, *Aug.* 13, 1934.—The statistical theory, previously developed and applied to the case of a single gas [see Abstract 4060 (1934)] is here extended to include a mixture of gases which may, or may not, react with one another. J. S. G. T.

See also Abstracts **4369, 4544, 4560, 4609, 4682, 4701, 4702, 4722.**

RELATIVITY AND ETHER.

See Abstracts **4433, 4446.**

SOLUTION.

4449. Activity Coefficients of Alkali Chlorides and Lithium Iodide in Aqueous Solution, from Vapour Pressure Measurements. R. A. Robinson and D. A. Sinclair. *Am. Chem. Soc., J.* 56. *pp.* 1830–1835, *Sept.,* 1934.—The vapour pressures of solutions of sucrose, LiCl, NaCl, RbCl, CsCl and LiI relative to those of a solution of KCl have been determined by an improved isopiestic method similar to that previously described [see Abstract 3711 (1933)]. From these vapour pressure data the activity coefficients of the five alkali halides are derived with an accuracy which is considered to be comparable with that obtainable in the e.m.f. and freezing-point methods. R. W. P.

4450. Activity Coefficient of Hydrochloric Acid at High Concentrations from Solubility Measurements. G. Akerlöf and H. E. Turck. *Am. Chem. Soc., J.* 56. *pp.* 1875–1878, *Sept.,* 1934.—An experimental study has been carried out regarding the possibilities of determining the activity coefficient of strong electrolytes at very high concentrations and in their pure solutions using solubility measurements for a co-solute. The case selected for the investigation was the ternary system hydrochloric acid—sodium chloride—water at 25°. The agreement found between solubility and vapour pressure values of the activity coefficient of hydrochloric acid was as good as reasonably could be expected over the entire concentration range within which an accurate comparison was possible. AUTHORS.

See also Abstracts **4424, 4452, 4453.**

SURFACE TENSION AND COHESION.

4451. Liquid Drops on the Surface of the Same Liquid. L. D. Mahajan. *Zeits. f. Physik,* 90. 9–10. *pp.* 663–666, *Sept.* 6, 1934.—A completion of previous work by the author [see Abstracts 3373 and 4791 (1933)]. A 15 % Boys soap solution was allowed to fall drop by drop into the same liquid at the bottom of a vessel in which the pressure was reduced by stages to 4 cm. of Hg. The height of fall was such that secondary drops formed on the surface of the liquid. The life of the drops was found to be 5 to 6 sec. at atmospheric pressure, half this at about 40 cm. of Hg and zero at 4 cm. of Hg. This is taken to prove that the liquid surface is separated from a liquid drop resting on it by a thin layer of the surrounding gas. P. H. B.

4452. Influence of Surfaces on Non-Stationary Reactions in Dilute Solutions of Strong Electrolytes. S. Oka. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 332–339, *Sept.,* 1934. *In German.*—The author has previously dealt with the properties of static ionic clouds [see Abstract 1353 (1933)], and here deals with non-stationary reactions. The influence of the liquid surface on the behaviour of the ions is calculated on the basis of the Debye-Falkenhagen theory. In the immediate neighbourhood of the surface the " force of relaxation " is found to be double that in the interior of the solution, and the conclusion is drawn that the surface reduces the ionic mobility. P. H. B.

4453. Interfacial Tension and Mutual Solubility. W. Ssementschenko, S. Gratschewa and E. Davidoffskaja. *Kolloid Zeits.* 68. *pp.* 275–286, *Sept.*, 1934.—The interfacial tensions and mutual solubilities for the system hexane-methyl alcohol in the presence of varying concentrations of fatty acids are studied, the former being measured by the drop-number method with the Lohnstein-Harkins corrections and the latter in terms of the critical mixing temperatures of the two main components. Similar measurements are described for the system nicotine-water in the presence of the same fatty acids and of simple electrolytes. It is found that surface-active materials increase the mutual solubility of the two components of such systems and reduce the range of incomplete mixing by raising the lower critical mixing temperature and by lowering the upper; the reverse occurs with materials increasing the interfacial tension. The results are considered from the standpoint of Boltzmann's principle and the generalised moments of the molecules concerned. L. V. C.

See also Abstracts **4392, 4397, 4414, 4417, 4431, 4743.**

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

4454. Gear Ratios for Converting Civil into Sidereal Time. A. E. Flanigan. *Rev. Sci. Instruments,* 5. *p.* 370, *Oct.*, 1934.—Simple ratios are computed which very closely approximate the ratio of the length of the civil second to that of the sidereal second, and which define gear trains for converting civil into sidereal time. AUTHOR.

VACUA, HIGH.

4455. Ionisation Gauge for Low Pressures. G. Spiwak and A. S. Ignatow. *Phys. Zeits. d. Sowjetunion,* 6. 1–2. *pp.* 53–68, 1934. *In German.*—Describes a form of ionisation gauge suitable for the measurement of very low pressures. In their common form, such as investigated by Dushman and Found, such gauges are limited in application by the low values of the ion (grid) current at low gas pressures; in the present type this difficulty is overcome by raising the grid to a considerable positive potential (*ca.* 50 V), so neutralising the space charge, and observing the variations in anode current. It is shown that many triodes are suitable for the purpose, and the circuit diagram is analysed in detail. Experimental results are given for various residual gases. It is shown that the change in electron current and the pressure are related through a logarithmic law. The gauge is suitable for use below 10^{-3} mm. of mercury or about 10^{-2} mm. pressure in other gases. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

4456. Calibration of Ostwald Viscometers. C. R. Bury. *Chem. Soc., J. pp.* 1380–1382, *Sept.*, 1934.—A convenient method is described of testing and calibrating an Ostwald viscometer, the disadvantages of previous methods being pointed out. This is based on the times of flow for a number of external pressures, the apparatus itself being similar in principle to that of Applebey [see Abstract 412 (1911)], but modified to give higher external pressures. H. H. Ho.

See also Abstracts **4388, 4397, 4500.**

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

4457. Prism Spectrograph of Tower Telescope, Tokyo Observatory. Y. Fujita. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 327–331, *Sept.,* 1934. *In English.*

4458. Mechanical Method of Reducing Radial Velocities to Sun. W. H. Christie. *Roy. Astron. Soc., Canada, J.* 28. *pp.* 297–302, *Sept.,* 1934.—The author solves by mechanical means the equation $v_a = V_a \sin(\odot - i - \lambda)\cos\beta$., giving a diagram illustrating the method of reduction to the sun, and a table of the earth's orbital velocity, V_a, and the deviation, i, when the sun's longitude is $\odot$. He describes the device which consists of a disc of 42 in. dia., free to rotate about its centre, and mounted on a supporting frame which is hung upon a wall at a convenient height. In actual practice it takes about 20 sec. to plot the position of a star and read off the sun's reduction. A. S. D. M.

See also Abstract 4454.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

4459. Final Character of the Motion in the Problem of Three Bodies. J. Chazy.—*Bull. Astronomique,* 8. 7. *pp.* 403–436, 1934.—The orbits are represented by trajectories in a configuration-space of twelve dimensions and the various types of orbits are studied for the cases when no collisions take place, *i.e.,* when the energy-constant is positive or negative but not zero. Applied to the system Sun-Jupiter, the theory shows that the system cannot be disrupted by the arrival of an external star provided a collision does not take place. The uniform integrals of the problem are also considered in some detail. G. C. McV.

See also Abstract 4461.

NEBULÆ.

4460. Surface Brightness of Elliptical Nebulæ. J. P. Reimer. *Zeits. f. Astrophysik,* 8. *pp.* 374–378, *Aug.* 28, 1934.—From data given in the Catalogue of Elliptical Nebulae by Shapley and Ames, Keenan deduced that these nebulæ show an increase of surface brightness with decreasing surface. This paradoxical conclusion, however, results from Keenan's method, which is in several ways misleading. If the surface brightness and the total brightness as given in the Catalogue is examined and compared, it appears that in fact the surface brightness of all the nebulæ is of the same order, and bears no relation to distance. The data of Wirtz give a different result, but this follows from a systematic difference in his measures of the nebular diameters, and those of Shapley and Ames are to be preferred. M. A. E.

PLANETS.

4461. Laws of Einsteinian Planetary Movement. G. Gargia. *Accad. Lincei, Atti,* 19. *pp.* 874–879, *June* 17, 1934.—Following up the paper of Cimino [see Abstract **4821** (**1932**)], the author discusses and solves the problem, reverting to Hamilton-Jacobi lines. A. D.

STARS.

4462. Numerical Solution of Integral Equation of Stellar Statistics. A. Brill. *Zeits. f. Astrophysik*, 8. *pp.* 379–388, *Aug.* 28, 1934.—A solution of the integral equation of stellar statistics $a(m) = \mathrm{k}\int_0^{\infty} \mathrm{D}(\log e) . e^2 . \phi(\mathrm{M}) de$ is given for the case in which the light of the stars is weakened by a general interstellar absorption. The method of calculation is very similar to that given in a previous communication for the case in which there is no absorption. [See Abstract **3600** (**1934**)]. J. E. K.

4463. Systematic Errors of Parallaxes. S. A. Mitchell. *Astrophys. J.* 80. *pp.* 200–228, *Oct.*, 1934.—A re-examination is made of the trigonometric parallaxes from eight observatories and of their differences from the revised (as yet unpublished) Mount Wilson spectroscopic parallaxes. It is concluded that the observations are sufficiently numerous to determine fairly satisfactorily the systematic error in zero point, but that in most cases there is too little material to detect real variation of the systematic error with right ascension. In coming to this conclusion, the parallaxes from the McCormick Observatory are considered in detail. After making harmonic analyses for various samples of the material by omitting stars with large parallaxes, the curves show few resemblances to one another. In particular, when parallaxes greater than $0''\cdot050$ are excluded, the curves derived from the remaining **546** stars shows almost no variation with right ascension. This curve should give the most reliable information concerning the McCormick parallaxes, since for these stars the accidental errors of the spectroscopic parallaxes may be disregarded. Comparisons are then made between the Allegheny series and that of McCormick. Finally, the probable errors of van Maanen's Fourier coefficients are derived for each of the eight observatories. From a consideration of these it is concluded that the periodic terms derived from the harmonic analyses have little physical significance. AUTHOR.

4464. Variations in the Eccentricity of the Orbits of Binary Systems. G. Bemporad. *Accad. Lincei, Atti*, 19. *pp.* 880–886, *June* 17, 1934.—Discusses, mathematically, the variations, under different circumstances in the orbits of binary systems through the influence of loss of mass due to the transformation of mass into energy. A. D.

4465. Orbits of Three K-Type Spectroscopic Binaries. W. H. Christie. *Mt. Wilson Observat., Contrib. No.* 499. *Astrophys. J.* 80. *pp.* 181–189, *Oct.*, 1934.—The orbital elements of three K-type spectroscopic binaries, corrected by least-squares solutions, are given. Among these are the elements of a dwarf star, the spectra of both components of which are measurable. AUTHOR.

4466. Puzzle of β Lyræ. O. Struve. *Observatory*, 57. *pp.* 265–274, *Sept.*, 1934.—Recent study of the two absorption Spectra of β Lyræ show that B_8 (better classed as B_9) is a normal supergiant and B_5 is completely abnormal and is almost wholly H and HeI, with extreme faintness (or absence) of MgII 4481, CII 4267, NII 3995, SiII 4128 and SiII 4131. The author suggests that the B_5 spectrum does not originate in a star, (comparing its abnormalities of absorption lines with those of Novae, P Cygni and 17 Leporis stars) but in an expanding shell of gas, and indeed from that part of the shell projected on the B_8 disc, and is therefore moving directly towards us. Amongst other results, of this revolutionary idea, is that B_5 need not be considered more massive than B_8, as has been assumed, and thus removes the difficulty that it must, at the same time, be taken as five times fainter (per unit surface) than the B_8. So too with the matter of colour. He suggests that the lines due to the eclipsing star are those of B_8 which are extremely diffuse and ill-defined at principal minimum. He discusses the rotational velocity of the stars, and finds that the eclipsing star has such large (as is common in A- and B-type stars) and he points out that if B_8 is more luminous than the secondary, there is no reason to suppose that the latter's fuzzy lines can be seen in a blended spectrum. Possibly the light of B_8 shines through the rapidly rotating atmosphere of the Ao component. He discusses the general case of reflection effect on the spectra of spectroscopic binaries. A. S. D. M.

4467. Spectrographic Studies in the Red. Y. Öhman. *Mt. Wilson Observat. Contrib. No.* 498. *Astrophys. J.* 80. *pp.* 170–180, *Oct.*, 1934.—A search for the forbidden Ca^+ lines failed in our own galaxy [see Abstract 552 (1930)] and in (1) M_{32} with the new Eastman I-N plates, very sensitive in the red. But in this region, M_{32} resembles the sun closely (M_{32} having stronger D-lines) and exhibits a dwarf character, the CN band between λλ 4144 and 4184 (typical of giants) being absent. (2) The Ca^+ lines are not found in celestial spectra generally, nor where the H and K lines are strongly emitted in both giants and dwarfs, but the two types show noticeable differences in (*a*) the TiO bands in the red and yellow region; (*b*) in two bands in the red with heads at λλ 7054 and 6159; and in (*c*) three bands in the green and blue with heads at λλ 5167, 4955, 4762. In (*a*) it has been shown [see Abstract 1509 (1934)] that TiO bands are stronger in M giants than M dwarfs. In (*b*) the band at head λ 6159 is found to be due to CaH and is the strongest in the CaH spectrum; it is well visible in M dwarfs but weak or invisible in M giants; CaH is well known in sunspots but has never before been found in stars. In (*c*), bands of MgH are also strong in sunspots and seem to appear in Mira Ceti. A tracing is given of the Mo dwarf 61^2 Cygni, which shows the Mg triplet (λλ 5183, 5172, 5167) much stronger and broader than in M giants and a comparison with Fowler's spectrum of MgH renders it certain that MgH is present in the spectra of late type stars. In the same tracing of 61^2 Cygni are strong Ca lines (λλ 6162, 6122, 6102) which vary with absolute magnitude, and are weak in giants, but also very strong in sunspot spectra. A. S. D. M.

4468. Identification of Lines in the Spectra of B Stars. P. Swings and M. Nicolet. *Astrophys. J.* 80. *pp.* 190–199, *Oct.*, 1934.—Identifications of lines in the spectra of B stars are given. About fifty lines for which no previous identifications had been made are interpreted. AUTHORS.

4469. Relative Stellar Energy Distribution in the Infra-Red. W. W. Morgan and B. A. Wooten. *Astrophys. J.* 80. *pp* 229–231, *Oct.*, 1934.—The relative spectral intensities of five stars have been determined at 0·87 μ and 1·0 μ by the use of the new Eastman special infra-red emulsions. The results extend the wave-length region observed by Jensen and confirm his conclusion that differential stellar energy-curves deviate markedly from the approximately linear relationship to be expected from Planck's law. AUTHORS.

4470. Stellar Atmospheres. H. N. Russell. *Frank. Inst., J.* 218. *pp.* 127–142, *Aug.*, 1934.—The growth of our knowledge of the composition of stellar atmospheres as deducible from the results of stellar spectography is traced from the pioneer work of Huggins and Lockyer to the more recent researches of Saha, Fowler and Milne. Attention is drawn to the many factors which influence the relative intensities of the spectral lines of elements in the stars and complicate the interpretation of spectra. The evidence is given for the belief that H is by far the most abundant constituent of stellar atmospheres. A simplified " model " atmosphere is considered which is composed of 1000 parts of H to one part of metals, three-fourths of the metals being Fe, three-fourths of the rest Na and the remainder K. Results are given of calculations of the extent of stellar atmospheres and of electron pressures therein, based on this model. The manner in which line and band intensities and the numbers of atoms engaged in the absorption of any particular line should vary for stars of different temperatures is also described. J. E. K.

4471. Period Errors of Variable Stars. T. E. Sterne. *Harvard Coll. Obs., Circ. No.* 386 [36 *pp.*] *and No.* 387 [23 *pp.*], 1934.—The author warns against the assumption that the errors of variable stars are non-cumulative, and are capable of being diminished by numerous and precise observations ; especially that least squares may underestimate the mean errors of the period. He gives methods for finding the mean non-cumulative and cumulative errors (e and s) for both l.p. and s.p. variables, and for the latter, a sensitive and powerful method of periodogram analysis. His methods bear certain resemblances to those of Eddington and Plakidis [see Abstract 1391 (1930)], but not in their interpretation. For the l.p. RR Scorpii, he finds no evidence of change of true period ($279^d \cdot 44 \pm 0^d \cdot 44$ (m.e.)) from 1846 to 1933 ; nor for the l.p. T Andromedæ ($280^d \cdot 70 \pm 1^d \cdot 14$ (m.e.)) from 1891–1933 ; there is no evidence of l.p. changes of true period of RR Lyræ ($0^d \cdot 56684186 \pm 0^d \cdot 00000506$ (m.e.)), but there is a real s.p. change of true period, not exact and constant ; the true period of Algol has changed between 1782 and 1931. The dates of minimum show ($2^d \cdot 8673429 \pm 0^d \cdot 0000037$ (m.e.)) between 1782 and 1840, and from 1840 to 1931 ($2^d \cdot 8672861 \pm 0^d \cdot 0000046$ (m.e.)). A. S. D. M.

See also Abstracts 4458, 4481.

SUN.

See Abstracts 4458, 4467, 4481.

GEOPHYSICS.

GEODESY.

4472. Figure of the Earth. N. Moïsseiev. *Gerlands Beitr. z. Geophys.* 42. 2–3. *pp.* 279–290, 1934.—In the derivation of the figure of the earth, *e.g.*, by the method of Stokes, it has been necessary to adjust the earth by moving all disturbing masses to the reference sphere or within it. Formulæ are now derived without using this adjusting process, so that the results correspond more closely to the real earth's surface. W. A. R.

LAND, PHYSICS OF THE.

4473. Classification of Clay-Slates by Optical and X-Ray Examination. B. Sander. *Zeits. f. Krist.* 89. 2. *pp.* 97–124, *Oct.*, 1934.—The application of optical and X-ray methods to the examination of tectonites is illustrated by nine samples of palæozoic clay-slates (essentially felted muscovite), six of liassic calciferous roofing slates containing mica flakes regularly, and quartz and calcite grains irregularly arranged, and two samples of more crystalline epimetamorphic blast opsammetic B-tectonites [see Knopf, *Am. J. Sci.* 25. *pp.* 433–470, *June*, 1933]. The relations of the various *s*-planes to the original stratification and to the *b* or B axes is worked out from the relative arrangements of mica flakes and other minerals as revealed optically and by X-rays, the deformation of fossils, etc. C. A. S.

4474. Exploration of Mineral World by X-Rays. W. L. Bragg. *Nature,* 134. *pp.* 401–404, *Sept.* 15, 1934. *Paper read before the British Assoc., Aberdeen, Sept.,* 1934.—The commonest elements occurring in rocks are classified according to the way in which they build up structures with oxygen, and the dependence thereof on the relative sizes of the atoms (or ions). The structures of the commonest minerals, quartz and felspar, micas, and pyroxenes and amphiboles are then shown to depend on the method of linking of the tetrahedral SiO_4 groups according as this is by 4, 3, or 2 corners respectively, while in olivine octahedrally surrounded Fe or Mg ions intervene between the SiO_4 tetrahedra. Relations between structure and properties are brought out, and the extreme regularity of the micas demonstrated by the regular growth thereon of NH_4I crystals. C. A. S.

4475. Flow of Oil into Oil Wells. S. F. Shaw. *Inst. Petroleum Technologists, J.* 20. *pp.* 891–900, *Sept.,* 1934.—Reference is made *inter alia* to previous work by the author, and to the investigations respectively of Hayward, and Marsh and Robinson. The various factors which condition the flow of oil into a well are stated and discussed. Curves are given to illustrate the relation between the flow of oil into a well and the pressure maintained at the bottom of the well; for the production in barrels per day and the output factor per barrel; to indicate the advantage of testing a well through two different strings of pipe; to show the relation between the quantity of oil that can be produced through a flow of pipe of given diameter, 4000 ft. in length with given bottom-hole pressure; and for the relationship between production and output gas in a 4000 ft. well. J. K.

4476. Two-Fluid Systems in Porous Media. Encroachment of Water into an Oil Sand. M. Muskat. *Physics,* 5. *pp.* 250–264, *Sept.,* 1934.—The problem of the encroachment of water into an oil sand is formulated as a new type of potential problem, namely, that of finding potential distributions in two regions of different " constants " (" conductivities ") which are separated by a surface, each point of which has a velocity proportional to the vector gradient of the potential at the point, and such that the area swept out by the moving interface assumes the " constant " appropriate to that of the encroaching side of the interface. The cases of strictly linear, radial and spherical systems, in which the shapes of the interfaces are evident from symmetry requirements, are solved in detail and discussed graphically. The zeroth approximation to the general problem which gives the history of a line of fluid particles in a homogeneous system is also treated in detail. Analytical and graphical solutions are presented for (1) systems with elliptical boundaries, (2) an infinite linear source driving fluid into an isolated sink, and (3) the history of a ring of fluid particles travelling from a source to a sink. The relation of the analytical results to the practical problems of the encroachment of water into oil-bearing sands is discussed both for the solutions of the general problem and those of the zeroth approximation. AUTHOR.

4477. Motion of Particles in Systems of Complex Potential Distribution. R. D. Wyckoff and H. G. Botset. *Physics*, 5. *pp*. 265–275, *Sept.*, 1934.—A method is described whereby the motion of the interface between two liquids of equal viscosity and density moving through a porous medium in systems of complex pressure distribution may be obtained by the use of electrolytic models. Experimental results for certain simple cases are compared with results obtained analytically and shown to be accurate to within 95–98 %. Illustrations are given of more complex cases showing the application of these models to some practical problems of oil-field technology. AUTHORS.

See also Abstract 4487.

METEOROLOGY.

4478. Absorption of Ultra-Violet Light in the Stratosphere and the Vertical Distribution of Ozone. E. and V. H. Regener. *Phys. Zeits.* 35. *pp*. 788–793, *Oct.* 1, 1934.—The amount of ultra-violet light in the diffuse sunlight reflected from the surface of magnesium oxide is determined by a self-registering spectrograph carried by balloons up to a height of 30 km. Careful correction is made for the effect of scattered sky light as distinct from direct sunlight. The maximum concentration of ozone occurs at a height of about 24 km. ; some 70 % of the total amount of ozone lies below a height of 30 km. F. C. C.

4479. Tornado at Peshawar. R. G. Veryard. *Indian Meteorolog. Soc., Sci. Notes*, 5. 56. *pp*. 109–116, 1934.—The passage of a tornado on 5th April, 1933, close to Peshawar is described. The meteorological conditions at different levels in the atmosphere before, during and after the passage of the tornado are illustrated by charts and diagrams. The origin of the phenomenon is discussed at length, the author pointing out the parts he considers to have been played by the various air masses. The appearance of the funnel shaped cloud at various stages in its passage is illustrated by photographs. A. E. M. G.

4480. Wind Structure and Evaporation in a Turbulent Atmosphere. O. G. Sutton. *Roy. Soc., Proc.* 146*A*. *pp*. 701–722, *Oct.* 1, 1934.—A theory of the transfer of momentum and mass in a turbulent medium is developed, which starts from the concept of an eddy as a mass of fluid which for some reason leaves its initial surroundings and moves as a discrete body continuously blending with the main mass of the fluid. The mixing path is defined as that distance through which an eddy moves relative to the main body of the fluid during the period necessary for the correlation between its initial and final velocities to become negligibly small. An empirical expression is suggested for the correlation coefficient and from this the law of variation of wind with height above the earth's surface is deduced. The theory is then extended to the problem of evaporation, on the assumption that the diffusion of mass follows the same laws as the diffusion of momentum, and expressions are found which are in good agreement with experimental data. AUTHOR.

4481. World Climate during the Quaternary Period. G. C. Simpson. *Roy. Meteorolog. Soc., J.* 60. *pp.* 425–471 ; *Disc.*, 471–478, *Oct.*, 1934.—The general effects of an increase in solar radiation from its present value leads to a general rise of temperature and increased winds, cloud and precipitation, with resulting changes in accumulation of snow and the extent of polar ice caps and ice fields as regards latitude and limits of height above sea level. Two cycles are traced in the Pleistocene period leading to (1) the Günz glacial epoch, the warm and dry Günz-Mindel interglacial, the Mindel glacial, and the cool and dry Mindel-Riss interglacial ; and (2) the Riss glacial, the warm and wet Riss-Würm interglacial, the Würm glacial, and the present cold and dry interglacial. The cycles are also shown diagrammatically. Reasons are given for the non-symmetrical character of the polar ice sheet about the N-pole in glacial epochs. The geological evidence, qualitative and quantitative, for the sequence of climate is discussed in detail and numerous references are given relating to the flora and fauna considered. The two corresponding pluvial periods in lower latitudes associated with the four glacial epochs are also discussed. From the geological record it is estimated that at the maximum of solar radiation the temperature was between 5° C. and 10° C. higher than at present, and that the cloud amount was increased from the present 0·5 to between 0·7 and 0·8. From these data it is calculated that the sun is a variable star with an amplitude of 20 % (range 40 %) in the intensity of the radiation and a period of the order of 10^5 years. R. S. R.

See also Abstracts 4547, 4621.

SEISMOLOGY.

4482. Inverse Boundary Value Problem in Seismology. C. L. Pekeris. *Physics*, 5. *pp.* 307–316, *Oct.*, 1934.—It is shown that the variation with depth of the density and elastic constants of a half-space can be determined from the observed motion of the surface caused by a given distribution of stresses on the surface. AUTHOR.

4483. Study of Emergence Angle and Propagation Paths of Seismic Waves. M. Ewing and A. P. Crary. *Physics*, 5. *pp.* 317–320, *Oct.*, 1934.—Travel-time curves are given for elastic waves through the earth in a region in which the velocity increases continuously with depth. These time-distance curves have been approximated by an equation of the form $X = aT^2 + bT$ from which the velocity depth relation has been deduced. A new method for measurement of the emergence angle has been used and the values obtained agree reasonably well with those deduced from theoretical treatment of the time-distance curve. Formulæ for the travel-time between any two points in the medium under consideration are derived. These formulæ agree closely with two sets of direct measurements. In one of these the seismograph was placed at various distances directly beneath the explosion. In the second case it was placed at a fixed depth beneath the surface and the explosion was located on the surface at various distances. The approximate depth to bed rock is obtained from the time-distance curves by use of the formulæ mentioned above. AUTHORS.

4484. Earthquake Stresses in Elastic Structures by Means of Models. A. C. Ruge. *Seismological Soc. of America, Bull.* **24.** *pp.* 169–230, *July*. 1934.—The author deals first with causes of failure in earlier methods, these being based upon unjustifiable assumptions, and states his view regarding the best method of approach to a thorough investigation of the seismic resistance of structures by making use of devices which will solve mechanically the intricate maze of equations. These devices include (1) model study with dynamically similar mechanical models; (2) model study using electrical networks whose response is analogous to that of the structures to be considered; (3) the differential analyser method; and (4) various combinations of (1), (2) and (3). In the paper consideration is given to (*a*) geometrically similar models with (*i*) elasticity only, and (*ii*) frictional forces also acting; (*b*) distorted-, and doubly-distorted-scale models of elastic rectangular frames without diagonal bracing; (*c*) the gravity effect in models and the method of preserving this effect in them; and (*d*) models of diagonal braced frames with rigid joints having light and heavier bracing systems. Finally, practical problems of model construction including types of joints, floor conditions, arrangements for loading, and torsional effects are treated and the probable accuracy of model results. R. S. R.

4485. Seismographic Recorder. H. Wolfe. *Rev. Sci. Instruments*, **5.** *pp.* 359–361, *Oct.*, 1934.—A recorder used for making ink records of low frequency oscillations of a small rotating mirror (such as, for example, a galvanometer mirror) is described: a light beam, modulated in accordance with the mirror vibrations, excites a photoelectric cell, the output of which is sufficiently amplified by a low frequency amplifier to control a penwriter. Since the instrument has been developed for use in in conjunction with photographically recording seismographs, the treatment in the article is from a seismological point of view. The frequency response of the recorder alone is calculated, and the method of obtaining it for the entire sytem of the recorder in combination with a given seismograph is indicated. Records are shown to demonstrate the fidelity of reproduction. AUTHOR.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4486. Diurnal Variation of the Space Charge and its Effect upon the Potential Gradient. C. H. Dwight. *Phil. Mag.* **18.** *pp.* 719–724, *Oct.*, 1934.—The space charge of the atmosphere is measured by a Faraday pail attached to an electrometer and readings are taken at known intervals. The potential gradient is obtained by the usual method of an insulated conductor, carrying an ionising agent, attached to an electrometer needle, the movement of which can be recorded on a drum. Results of both experiments are correlated and it is found that the maximum value of air potential is coincident with the minimum of the space charge. H. M. B.

RADIOACTIVITY.

4487. Radium Content of Connate Waters. H. G. Botset. *Physics*, 5. *pp.* 276–280, *Sept.*, 1934.—A method is described for measuring the radium content of natural waters. The method is shown to be accurate to within a few per cent for concentrations as low as 100×10^{-12} g. Ra/l. Results are given of measurements on several connate waters from mid-continent oil fields. A correlation between Ra and Ca content of the waters is indicated. Samples taken from the same wells over a period of several months indicate that the Ra concentration is a definite property of a connate water. AUTHOR.

4488. Working Model for Showing Nuclear Disintegrations. R. M. Sutton. *Am. Phys. Teacher*, 2. *pp.* 115–116, *Sept.*, 1934.—A graphic representation of nuclear bombardment is produced by rolling small steel balls ("α-particles") across the convex surface of a large watch-glass, at the topmost point of which is placed an opaque tubular housing representing the nucleus. Within the " nucleus " are placed other steel balls ready to roll off when struck. The illusions of nuclear repulsion of α-particles, ejections of neutrons and protons from the nucleus by α-particles, and the capture of α-particles by the nucleus are obtained by controlling the speed of the projectile balls. The watch-glass is illuminated in a vertical projector to produce a large-scale shadow picture of the field of action. AUTHOR.

4489. Theory of Anomalous α-Ray Scattering. P. Wenzel. *Zeits. f. Physik*, 90. 11–12. *pp.* 754–763, *Sept.* 17, 1934.—A mathematical paper in which it is shown that the anomalous scattering depends on a single parameter involving the form of the nuclear field. The maximum scattering at 180° is calculated for several light elements as a function of the α-particle velocity. The curves so obtained are used in the discussion of experimental results [see Abstract 1278 (1932)]. W. E. P.

4490. Range and Absorption of Natural H-Rays. E. Frank. *Zeits. f. Physik*, 90. 11–12. *pp.* 764–772, *Sept.* 17, 1934.—The paper gives the results of the measurements of the absorption in mica, tin and gold of the H-particles emitted by thin paraffin foils bombarded by Po α-particles. The absorption curves obtained show the presence of groups of H-particles. The mechanism of the collision process occurring between α-and H-particles is discussed and the present results are compared with those previously obtained by the scintillation method. [See following Abstract.] W. E. P.

4491. Scattering of α-Particles by H-Nuclei. H. Pose and K. Diebner. *Zeits. f. Physik*, 90. 11–12. *pp.* 773–778, *Sept.* 17, 1934.—The author has investigated the absorption of H-particles in more detail, using α-particles of various ranges [see preceding Abstract]. The experimental values of the number of H-particles in the groups are compared with values calculated from Rutherford's theory and from quantum mechanics. W. E. P.

4492. Spectrographic Investigation of γ-Rays by Crystalline Diffraction. J. N. Valadares. *Ann. de Physique*, 2. *pp.* 197–240, *Sept.*, 1934.—The paper describes the detailed study of the γ-ray spectra of Ra

(B + C), MsTh, RaTh, etc., in the region 100 to 250 X, using 2nd and 3rd order spectra. The intense rays of Ra (B + C) are shown to be fluorescent rays. Certain lines attributed previously to RdTh are found to be emitted during the transformation ThB → ThC and several new lines are found to be present in the spectra of the thorium series. By using a 1-gm. source, the K X-ray spectrum of Ra was obtained, for the first time. The numerical results of an investigation of the magnetic spectra of the α-rays of ThC are given and these and other results are discussed in connection with Gamow's theory. W. E. P.

4493. Apparatus for Counting α-Particles. R. Grégoire. *Ann. de Physique*, 2. *pp.* 161–196, *Sept.*, 1934.—An apparatus is described for determining the number of α-particles emitted per second by a radioactive preparation. The total charge carried by the particles is measured by an electrometer connected to an electrode placed opposite the source in an evacuated chamber. The precautions taken to avoid errors due to δ-rays are given in detail. The author has used the apparatus to determine the number of pairs of ions produced by a Po α-particle and to carry out various measurements in connection with the α-rays and recoil rays of Po and the active deposit of thorium. W. E. P.

4494. Statistical Distribution in Angle of Particles in Wilson Chamber. N. Dobrotin. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 241–244, *Aug.* 1, 1934. *In English.*—In studying statistical distribution in angle of particles, such as the Compton effect and recoil nuclei projected by neutrons, the problem is simplified in consequence of the existence of an axial symmetry in the direction given by the primary pencil causing the secondary particles under observation. In this case the function of distribution in spatial angles can be obtained from the projection of the tracks on one plane. Thus the necessity of stereoscopic photographs for such statistical studies is obviated. [See Abstract 2180 (1934).] J. J. S.

See also Abstracts 4367, 4670, 4671, 4673, 4698, 4699, 4761.

V.
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RADIATION.

ABSORPTION AND TRANSMISSION.

4495. Transmissivity Measurements in the Spectral Region 50–240μ. C. H. Cartwright. *Zeits. f. Physik*, 90. 7–8. *pp.* 480–488, *Sept.* 4, 1934.—A continuation of the work of Barnes [see Abstract 2830 (1932)]. The transmissivity of quartz, glass, paraffin, resin, mica, sulphur, cellophane, bakelite, gum, papers and other substances used as filters or blackening mediums is measured. The influence of size of grain on the transparency of powdered salts is also investigated. W. R. A.

See also Abstracts 4406, 4526, 4543.

COLORIMETRY.

4496. Complementary Hues for Standard Observers. I. H. Godlove. *J.O.S.A.* 24. *pp.* 264–266, *Oct.*, 1934.—Gives the complementary wave-length pairs for the O.S.A. and International Illumination Commission standard observers using as "white" mean noon sunlight. The method used was that previously described by the author [see Abstract 3963 (1930)]. The O.S.A. and I.C.I. curves are approximately parallel and differ by 2 to 4 millimicrons; both, however, lie generally within the range of Sinden's observational data [see Abstract 1417 (1924)]. J. W. T. W.

4497. Colorimetry with a Colour Atlas. I. H. Godlove and A. E. O. Munsell. *J.O.S.A.* 24. *pp.* 267–271, *Oct.*, 1934.—Examines the precision that may be obtained by using the Munsell colour charts for describing the colour of a pigmented sample. Hue and chroma (saturation) were measured for 32 different samples (*a*) directly by comparison with the Munsell standards and (*b*) by obtaining spectrophotometric data and computing from these the hue and chroma of each sample when illuminated by mean noon sunlight, assuming the characteristics of the O.S.A. observer. The results are tabulated in terms of the steps in the Munsell scale. It is found that the uncertainty of the direct method as estimated from the differences found between the two methods is about one Munsell hue step and one-half a Munsell chroma step. The hue agreement is best for the blues and worst for the yellows, especially the yellow-reds. The contrary is the case for the chroma agreement.
J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4498. Magnetic Anisotropy of Fatty Acids. A. Piekara. *Comptes Rendus*, 199. *pp.* 527–529, *Aug.* 27, 1934.—Magnetic birefringences for some fatty acids and for acetic anhydride are reported. The temperature variation for acetic acid and acetic anhydride, between 20° and 80°, shows a slight decrease. The possibility of calculating the magnetic anisotropy from the Langevin formula is discussed. [See Abstract 2165 (1934).] N. M. B.

4499. Magnetic Rotation of PH_3 and AsH_3. R. de Mallemann and P. Gabiano. *Comptes Rendus*, 199. *pp.* 600–601, *Sept.* 17, 1934.—The Verdet constant for AsH_3 is measured and found to be $\Lambda_0^{760} = 68 \times 10^{-6}$ (min.) and the molecular rotation $[\Lambda]_M = 44 \times 10^{-5}$ (radian). That for

PH_3 is found to be $\Lambda_0^{760}=57\times10^{-6}$ (min.) and the molecular rotation $[\Lambda]_m=36\cdot5\times10^{-5}$ (radian), giving for the atomic rotation of phosphorus 31×10^{-5} (radian) and for arsenic $38\cdot5\times10^{-5}$ (radian). R. L.

See also Abstracts 4558, 4559, 4756.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4500. Influence of Viscosity on Fluorescent Power. J. Bouchard. *Comptes Rendus*, 199. *pp.* 460–462, *Aug.* 13, 1934.—In previous papers in the formula $\phi=\phi_0\cdot e^{-k\tau}$, which is taken to be the relation between fluorescence and concentration, the constant K is given as $1/(A-B\epsilon)$, where ϵ is the specific inductive power. Measurements made on uranin in glycerin solutions of varying viscosity show that the constant K^1, given by $K^1=K+[K_0-K_0/(1-BK_0(e-e_0))]$, where the 0 suffixes refer to aqueous solutions, decreases with viscosity to a limit and depends only on the viscosity independently of the solute which gives a particular value. J. E.

4501. Ultra-Violet Fluorescence of NaCl Crystals Coloured by X-Rays. W. Kudrjawzewa. *Zeits. f. Physik*, 90. 7–8. *pp.* 489–503, *Sept.* 4, 1934.—An account is given of investigations of the ultra-violet fluorescence produced by the incidence of visible light upon NaCl crystals coloured with X-rays. For this purpose a method is worked out whereby the photoelectric photon-counter can be used as a spectral apparatus by the addition of a grid electrode and observation of the number of responses as a function of the grid potential. The dependence of the intensity of fluorescence upon the exciting wave-length is investigated and the fluorescence is found to consist of two bands with centres at about 250 and 150 mμ. Ultra-violet phosphorescence is also observed at the latter wave-length. The results are discussed in terms of the electronic energy levels of the crystals. L. A. W.

4502. Phosphorescence. Part I. W. L. Lewschin and W. W. Antonow-Romanowsky. *Phys. Zeits. d. Sowjetunion*, 5–6. *pp.* 796–810, 1934. *In German.*—Investigations on a large number of phosphorescent ZnS preparations—varying in relative brightness in a ratio of 3000 to 1—have shown that the law of decay is $J=At^{-a}$. This law was also found to be true with Lenard phosphors. The limits of its application are investigated since it is obviously not true in the initial stages ($t\rightarrow0$). It is found to hold over practically the whole of the observable decay and can therefore safely be used in any practical case. [See following Abstract.] J. E.

4503. Phosphorescence. Part II. W. L. Lewschin, W. W. Antonow-Romanowsky and L. A. Tumerman. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 811–837, 1934. *In German.*—The quenching effect of infra-red has been studied. There is no effect on the total light output nor is the law of decay altered in character. It is found that for specified regions of decay and for not too great a degree of quenching, the law $L\phi=Ae^{-k\tau}$ holds, where $L\phi$ is the remaining light sum in the phosphor and τ the light sum of the quenching radiation. K, the quenching constant is a function of the wave-length of the quenching radiation. The decrease of blackening of a photographic plate produced by the quenching light L^τ follows the ordinary photographic law of blackening. This offers a possibility of quantitative as well as qualitative infra-red photography. [See preceding Abstract.] J. E.

4504. Phosphorescence of Glass Solarised by Soft X-Rays. H. Kersten and C. H. Dwight. *J.O.S.A.* 24. *pp.* 285–286, *Oct.*, 1934.—The variation of the phosphorescence with the time of irradiation was measured by the photographic blackening produced on similar pieces of film, the blackening being measured by a "photronic" photometer. The decay of the phosphorescence was measured in a similar manner. The two curves are the same as those obtained by Swindells for calcium tungstate. There appears to be a correlation between solarisation and phosphorescence both as regards the total effect produced by irradiation and the decay after radiation is cut off. J. E.

4505. Effect of Temperature and Pressure on the Mercury Afterglow. D. W. Carpenter and W. M. Nielsen. *Phys. Rev.* 46. *pp.* 607–612, *Oct.* 1, 1934.—Measurements have been made on the rate of escape of resonance radiation from a slab of mercury vapour 4·0 cm. thick. The measurements extended over a range of pressures from 0·133 to 0·720 mm. of mercury and over a range of temperature from 390° to 585° K. Calculations have also been made of the decay constants on the basis of Kenty's theory of radiation diffusion. The variations of the disagreement between the experimental results and Kenty's theory as affected by both pressure and temperature are hence made available. Some of the difficulties for present theories in the interpretation of the experimental results are pointed out. AUTHORS.

See also Abstract 4512.

INTERFERENCE. DIFFRACTION AND SCATTERING.

4506. Fine Structure of Lines of Rayleigh Scattering in Liquids. W. Ramm. *Phys. Zeits.* 35. *pp.* 756–773, *Oct.* 1, 1934.—Light scattered by various organic liquids is investigated by means of two echelon gratings for the purpose of studying the fine structure of the scattered lines resulting from the scattering process. Using the Zn line 4680 Å, which is free from satellites, and observing at the scattering angle of 180°, it is found that the scattered spectrum contains, in addition to the primary line, two new lines of equal intensity displaced respectively to the red and to the blue by an amount (*e.g.*, 0·043 Å for CCl_4) which is in good agreement with Brillouin's theory of scattering. A résumé of this theory, in which the light is regarded as scattered by the elastic waves in the liquid, is also given. The triplet formed by the undisplaced line and the two displaced lines is superimposed upon a continuous broadening effect, the intensity of which is proportional to the anisotropy of the scattering molecule. The results obtained are held to supersede the conflicting reports of previous workers. L. A. W.

4507. Jamin Polarisation Interferometer. A. Cotton. *Rev. d'Optique*, 13. *pp.* 153–166, *May*, 1934.—In 1868, Jamin devised a " polarisation " interferometer which has become almost forgotten. It consists of two calcite rhombs between which is a half-wave plate, the whole being placed between two nicol prisms. A theory of the fringes produced by this apparatus is developed, with the help of Raveau's results for the localisation of interference fringes and a geometrical analysis of the retardation introduced by a crystal plate. It is shown that the apparatus has a number of special advantages, and can be used for the study of absolute retardation or for interferometric measurements in the near ultra-violet. [See following Abstract.] C. B. A.

4508. Application of the Jamin Polarisation Interferometer to the Measurement of Absorption Coefficients of Cobalt Sulphate. P. Barchewitz. *Rev. d'Optique*, 13. *pp.* 167–178, *May*, 1934.—The adjustment of the instrument is described and the character of the fringes produced by it is indicated. It is then applied to precision measurement of the absorption coefficients of cobalt sulphate in aqueous and sulphuric acid solutions. The results are described and discussed. [See preceding Abstract.] C. B. A.

4509. New Interference System. Q. Majorana. *Comptes Rendus*, 199. *pp.* 552–554, *Sept.* 3, 1934. *N. Cimento*, 11. *pp.* 518–530, *Aug.–Sept.–Oct.*, 1934.—In a short note, a device called a monoprism is described, with which interference is produced in a pencil of light from a point source, one-half of the light passing through a prism of small angle and the other half passing directly behind the base of the prism. The interference system differs from the Fresnel biprism in the higher order of the fringes that are produced. The device is simple but sensitive, and can be used for measuring the refractive index of a gas and for observing the Doppler effect and other similar phenomena. W. D. W.

4510. Equalisation of Temperatures of Interferometer Tubes. J. J. Manley. *Phys. Soc., Proc.* 46. *pp.* 745–746, *Nov.*, 1 1934.—This note is a description of two devices used for establishing and maintaining equality and uniformity of temperature for the contents of the twin tubes of Jamin interferometers. According to one method the tubes are closely wound from end to end with spirals of soft copper wire, s.w.g. 18. The other device consists of an aluminium chamber which during idle periods, completely encloses the tubes. Shutters, covering the ends of the tubes, are removed prior to the carrying out of measurements. AUTHORS.

See also Abstract 4634.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4511. Spectroscopy and Photochemical Decomposition of Acetone. R. G. W. Norrish, H. G. Crone and Olive D. Saltmarsh. *Chem. Soc., J. pp.* 1456–1464, *Sept.*, 1934.—The absorption spectrum of acetone consists of a region of discrete absorption at 3340—about 2950 Å and one of continuous absorption, devoid of structure, at about 3000–2200 Å. Visual and photographic study shows that the fluorescence of acetone vapour increases in intensity as the pressure rises to 180 mm. and is not appreciably affected by inert gases, but the intensity is diminished and the colour changed by oxygen, probably owing to the specific reaction of excited acetone molecules with oxygen and to the production of a second (transient) fluorescent substance. The existence of a region of infra-red absorption between 7000 and 10000 Å is confirmed. The fluorescence is stimulated only by absorption in the part of the spectrum showing discrete structure, no fluorescence being caused by absorption in the continuous region. The main products of the photodecomposition of acetone, which occurs in both the region of fine structure and the continuum, are CO and C_2H_6, with a small amount of CH_4. The quantum efficiency is 0·2 at $\lambda = 3150$ and 0·4 at $\lambda = 2650$. It is concluded that the decomposition does not involve the bimolecular reaction of excited molecules, but that primary dissociation occurs to form CO and free hydrocarbon radicals, the latter then combining to give ethane. Even in the region of continuous absorption this process is quite inefficient, and a polyatomic molecule in a state of predissociation may degrade its energy to heat instead of decomposing. T. H. P.

4512. Photochemical Decomposition and Fluorescence of Acetone Vapour. C. F. Fisk and W. A. Noyes, Jr. *J. Chem. Phys.* 2. *pp.* 654–658, *Oct.*, 1934.—A thorough understanding of the photochemical decomposition of acetone vapour must be accompanied by a study of the fluorescence of this substance. Previous work had indicated that the fluorescence is relatively weak, is affected by oxygen and (at least over part of the spectral range involved) possessed a fine structure. In the present work it is shown that the intensity of the fluorescence follows the customary behaviour observed in such phenomena in that it is quenched by the acetone vapour itself. A discussion is given as to the relationship of the fluorescence to the possible modes of photochemical decomposition. AUTHORS.

4513. Influence of Foreign Bodies in the Photochemical Reaction $2SO_2 + O_2 \rightleftarrows 2SO_3$. M. Trautz and F. Helfrich. *Zeits. f. wiss. Phot.* 33. *pp.* 111–116, *Sept.*, 1934.—The validity of the law of mass action for the above chemical reaction is verified when additions of N_2 and A are made. The course of the reaction in the complete absence of water vapour is examined and the formation of ozone as an intermediate product is postulated, its formation being independent of the presence of water vapour. The absorption of various gas filters for the radiation emitted by a mercury lamp is investigated and it is found that a 3 mm. layer of SO_2 completely absorbs this radiation. [See following Abstract.] H. J. H. S.

4514. Validity of Law of Mass Action for the Photochemical Reaction $2SO_2 + O_2 \rightleftarrows 2SO_3$. M. Trautz and F. Helfrich. *Zeits. f. wiss. Phot.* 33. *pp.* 117–122, *Sept.*, 1934.—The conditions necessary for the validity of the law of mass action in photochemical ractions are discussed. It is shown that, in the case of an irradiated homogeneous gas equilibrium, the recognition of certain simple thermodynamical considerations is essention for the validity of the law. [See preceding Abstract.] H. J. H. S.

4515. Photochemical Decomposition of Sulphur Dioxide. G. Kornfeld and M. McCaig. *Faraday Soc., Trans.* 30. *pp.* 991–994, *Oct.*, 1934.—In the absorption spectrum of SO_2 between 3100 and 2500Å no trace of new bands has been found by irradiation with an aluminium spark. That means, that SO cannot be present in any appreciable concentration, although it is produced by the photochemical reaction. It must therefore react very quickly, in striking contrast to its normally slow reactivity, as established by Cordes and Schenk. The possible reactions are discussed with regard to a paper of J. Franck, H. Sponer and E. Teller and to the recent experiments of K. Wieland. [See Abstract 1179 (1934).] AUTHORS.

4516. Photochemical Retardation and Phototropic Effect. M. Trautz and H. E. Haas. *Zeits. f. wiss. Phot.* 33. *pp.* 81–93, *Aug.*, 1934.—A review is given of the rival photochemical theories of photochemical retardation and phototropy (polarised light effect). The theoretical foundations and chemical kinetics of each theory are considered and the mechanism of the phototropic effect is briefly outlined. A list is given of the recent literature on the subejct. H. J. H. S.

4517. Densitometry and Photographic Printing. Illumination of the Negative and Its Effect upon Density. C. Tuttle. *J.O.S.A.* 24. *pp.* 272–278, *Oct.*, 1934. *Comm. No.* 535 *from the Kodak Research Lab.*—The nature of the photographic image is such that the value of density is dependent upon the optical system in which the image is employed. Lightscatter by the embedded silver particles has been thoroughly discussed in the literature of photography, but, for the most part only the extreme systems of densitometry—" diffuse " and " specular " have been considered. This paper summarises the previous conclusions and extends the discussion to certain intermediate optical systems of practical importance. AUTHOR.

4518. Negative Illumination in Projection Printing. C. Tuttle. *J.O.S.A.* 24. *pp.* 279–284, *Oct.*, 1934. *Comm. No.* 536 *from the Kodak Research Lab.*—Diffusion in the illumination of a negative to be printed by projection affects the image contrast, the print graininess, the delineation of scratches, and the quantity of light available for printing. These four factors are discussed separately and, from the quantitative results obtained, certain general conclusions regarding the required amount of diffusion for a given type of enlarger are drawn. AUTHOR.

4519. Theories of Photographic Development. Part II. Adsorption of Hydroquinone on Colloidal Silver. A. J. Rabinowitsch and S. Peissachowitsch. *Zeits. f. wiss. Phot.* 33. *pp.* 94–104, *Aug.*, 1934. —By titrating the ultrafiltrate of hydroquinone solutions to which Ag sol has been added, it is shown that only a certain amount of the hydroquinone remains in the filtrate; the remainder has been partly oxidised and partly adsorbed in another form on the Ag particles. An analytical method is developed to estimate the amount of hydroquinone effectively adsorbed. This is shown to be very small and seems to indicate that the surface of the Ag particles is much greater than that deduced from the number of particles. The strong adsorption of hydroquinone on Ag particles provides experimental evidence in support of one of the theories of development given in a previous paper. [See Abstract 3674 (1934).] H. J. H. S.

4520. Spectral Sensitivity of the Silver Salts of Organic Dyes. G. Ungar. *Zeits. f. wiss. Phot.* 33. *pp.* 123–128, *Sept.*, 1934.—Gives results of experimental determination of the spectral sensitivity of silver salts of several organic dyes. These show that the principal region of the spectral sensitivity does not coincide with the region of greatest absorption, but that the greatest chemical action occurs in that part of the spectrum in which the absorption is small. R. C. F.

4521. Effect of the Dispersion of Different Types of Sensitometric Wedges on their Copying Characteristics. E. Spiller. *Phys. Zeits.* 35. 753–756, *Oct.* 1, 1934. *From the Reichsanstalt.*—Experimentally examines the difference in the copy density produced when using two wedges of similar densities but of different structures. The two wedges used were fine-grained graphite and coarse-grained photographically-obtained wedges, the results always indicating higher copy densities with the coarse-grained wedge. The differences obtained are due to the variation of the spectral transmission of the fine-grained wedge in the ultraviolet part of the spectrum. This is a diffraction dispersion dependent upon the wave-length of the light in contradistinction to that due to reflection obtained with the coarse-grained wedge. These density differences lie within the DIN tolerance limits. R. C. F.

4522. Solarisation. Part VII. Relationship between Solarisation and Time of Development. H. Arens. *Zeits. f. wiss. Phot.* 33. *pp.* 105–110, *Sept.*, 1934.—Examines the influence of the time of development upon solarisation and shows that this phenomenon more or less disappears with very long development times. This is apparently due to the fact that the long development times enable the active nuclei inside the silver bromide grains to be developed. [For Part VI see Abstract 2968 (1933).] R. C. F.

See also Abstract 4525.

PHOTOMETRY.

4523. Effect of Field-Shape in Bunsen-Lummer Photometer. H. Schober. *Zeits. f. Instrumentenk,* 54. *pp.* 305–309, *Sept.,* 1934.—The paper describes a series of experiments in which different shapes of field were used in the photometer and records the effect on the accuracy of measurement. Circular, rectangular and star-shaped fields, and others with either vertical or horizontal bands were tested for both coloured and white lights. The rectangular field and the one with vertical bands appeared to be the most satisfactory. W. D. W.

4524. Quantitative Photographic Photometry. W. H. E. Bandermann. *Zeits. f. Physik,* 90. 3–4. *pp.* 266–278, *Aug.* 10, 1934.—Measurements of the variations of emulsion thickness over commercial dry plates showed that these variations are always large and may amount to 2 : 1. The major uncertainties in photographic photometry are attributed to this cause and, it is proposed that before exposure the emulsion thickness distribution over the plate should be determined using a special infra-red photometer. With the aid of an "emulsion wedge" the characteristic density-exposure curves for different emulsion thicknesses could be determined and the necessary corrections applied when interpreting the measured densities on the original plate. The transmissions in the infra-red of various emulsions and glasses used for plates, are described in connection with the proposed method. W. S. S.

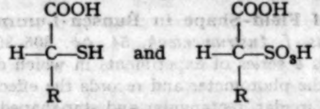
4525. Equality Densitometer. Jobin and Yvon. *Rev. d'Optique,* 13. *pp.* 179–182, *May,* 1934.—The paper describes an apparatus for comparing the densities of two spectrum photographs, and in particular for determining the wave-lengths at which the densities in the two photographs are equal. A polarisation method of intensity control is employed. W. D. W.

4526. High-Precision Rotating Sector for Measurement of Light Intensity. G. Kortüm. *Zeits. f. Instrumentenk.* 54. *pp.* 373–377, *Oct.,* 1934.—A description is given of the construction and test of a rotating sector, for use in photoelectric absorption spectrophotometry, which allows of the measurement of density (log I_0/I) with a probable error of 0·1 % for very low densities (0·14) and increasing accuracy at higher values. C. B. A.

POLARISATION.

4527. Radiation Damping and the Polarisation of Fluorescence Radiation. G. Breit and I. S. Lowen. *Phys. Rev.* 46. *pp.* 590–597, *Oct.* 1, 1934.—If the distance between two or more energy levels is comparable to their natural breadth, the levels cease to act independently. The coupling between the levels is then describable by means of a "damping constant matrix." The usual discussions concern themselves with a diagonal damping constant. Below a systematic treatment of emission, absorption and fluorescence is given without this restriction and it is shown how in general the frequencies of emission lines are affected by this radiation coupling. The theory is applied to the calculation of the polarisation of fluorescence radiation. It is shown that the coupling state of the lower group of levels of the fluorescence line does not influence the polarisation. Results of detailed calculations are given for the polarisation of Hα excited by absorption of the second line of the Lyman series. AUTHORS.

4528. Analysis of Rotatory Dispersion Curves. P. A. Levene and A. Rothen. *J. Chem. Phys.* 2. *pp.* 681–688, *Oct.*, 1934.—The rotatory dispersion curves of substituted fatty acids of the types



$$\mathrm{H{-}\overset{\overset{\textstyle COOH}{|}}{\underset{\underset{\textstyle R}{|}}{C}}{-}SH} \quad \text{and} \quad \mathrm{H{-}\overset{\overset{\textstyle COOH}{|}}{\underset{\underset{\textstyle R}{|}}{C}}{-}SO_3H}$$

have been measured in the visible and ultra-violet regions. The results are in harmony with the rule previously reported that in members of homologous series, the total rotation of consecutive members may differ in sign, but the signs of the partial rotations remain constant. AUTHORS.

4529. Anisotropic Effects between Crossed Nicols in Incident Light. M. Berek. *Zeits. f. Krist.* 89. 2. *pp*, 125–143, *Oct.*, 1934.—The appearances presented by sections of anisotropic minerals in incident light between crossed nicols are described when the polarisation of the incident beam is accurately homogeneous and linear, and when, as is usually the case, it is heterogeneous and has both azimuthal and elliptic irregularities, a knowledge of which is most important for the determination of the examined mineral. Directions for avoiding these difficulties are given in practical language. C. A. S.

4530. Theory of Anisotropic Effects between Crossed Nicols in Incident Light. M. Berek. *Zeits. f. Krist.* 89. 2. *pp.* 144–155, *Oct.*, 1934.—The various appearances resulting from accurate and defective polarisation [see preceding Abstract] are dealt with mathematically. C. A. S.

See also Abstracts 4507, 4508, 4590.

RADIATION, EMISSION.

4531. Generalisation of the Formula for Black-Body Radiation. E. Császár. *Zeits. f. Physik*, 90. 9–10. *pp.* 667–673, *Sept.* 6, 1934.—If, in deducing the Planck radiation formula by Einstein's method, the probabilities of absorption and induced emission by an atom are assumed to be not quite proportional to the radiation density, a correction to the Planck formula is required, which the author evaluates. Whether such a correction is necessary depends on the observed values of the constants h, k and σ (Stefan's constant). The numerical values suggest that a small correction may be called for. W. S. S.

4532. Blackness of a Black-Body Radiator. F. A. Cunnold and M. Milford. *Phil. Mag.* 18. *pp.* 561–566, *Oct.*, 1934.—A short summary is given of the theoretical methods of determining the blackness of a black-body radiator. The sources of error which may occur in the tubular type of radiator are mentioned. An experimental method of determining the blackness of such a radiator is described. The radiation from two holes drilled in the walls of the tube is measured with an optical pyrometer. One hole is kept constant in size, but that of the other is varied. The difference in radiation is expressed in terms of the apparent differences in temperature and the blackness for various sizes of hole is measured. The method may be applied to correct the calibration of a pyrometer. H. J. H. S.

4533. Cosmic Ray Ionisation-Depth Data. W. F. G. Swann. *Phys. Rev.* 46. *pp.* 432–434, *Sept.* 1, 1934.—The author has previously put forward [*ibid.* 43. *p.* 945, 1933] the hypothesis that corpuscular rays with energy comparable to 10^{10} volts do not produce ionisation in the usual sense, though they may produce "showers," and he shows here that the results of Clay, who found that at great depths below the surface of the sea the ionisation first increases with further increase in depth, and then falls off suddenly to zero [see Abstract 2475 (1934)], are consistent with this hypothesis. He deduces from these results that corpuscles of energy above a limit of 5×10^9 to 8×10^9 should not ionise. D. H. F.

4534. Mean Penetrating Power of Cosmic Radiation. B. Gross. *Phys. Zeits.* 35. *pp.* 746–747, *Sept.* 15, 1934.—It is shown that the mean penetrating power of radiation incident at all angles is equal to one-half that of radiation incident from one direction only. D. H. F.

4535. Measurement of the Penetrating Radiation in the Upper Atmosphere with the Tube Counter. E. Regener and G. Pfotzer. *Phys. Zeits.* 35. *pp.* 779–784, *Oct.* 1, 1934.—Previous work [see Abstract 174 (1934)] on the penetrating radiation up to a height of 27 km. with an ionisation chamber was corroborated with a special tube counter 20 mm. long and 15 mm. dia. sealed in a glass envelope. The number of impulses increased rapidly with height but above 18 km. a constant value was registered. The specific ionisation, which was the same at all heights, was 103 J/cm., a result in fair agreement with previous estimates by other experimenters. F. C. C.

4536. Measurement of the Penetrating Radiation in the Upper Atmosphere with an Open Ionisation Chamber. E. Regener and R. Auer. *Phys. Zeits.* 35. *pp.* 784–788, *Oct.* 1, 1934.—Previous work [see Abstract 174 (1934)] on the penetrating radiation in the upper atmosphere with an open ionisation chamber is continued. A chamber of double the original volume is used, careful precautions are taken to eliminate temperature effects and layers of paraffin wax are introduced to detect the presence of neutrons. The results are essentially the same as those previously obtained and it is concluded that neutrons can play little part in the primary penetrating radiation processes. F. C. C.

4537. Variation of Cosmic Ray Intensity with Height at Different Latitudes. H. Hoerlin. *Phys. Zeits.* 35. *pp.* 793–795, *Oct.* 1, 1934.—Measurements were taken at different heights on mountains at 49° N. and 2° N. geomagnetic latitude, using ionisation chambers. The difference between the ionisation at a given height for the different latitudes increases with the height, satisfactory numerical agreement being obtained with previous results by other observers. The results are thus in accordance with an increase of the latitude effect with height. D. H. F.

4538. Intensity Variations of Cosmic Radiation at 2300 m. V. F. Hess, H. T. Graziadei and R. Steinmaurer. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 5–6. *pp.* 313–338, 1934.—This paper summarises the results obtained with continuously recording ionisation chambers over a period of nearly three years at the Hafelekar station, 2300 m. above sea level. The main conclusion is that, after results are corrected for pressure and temperature variations, a definite daily variation emerges, showing a maximum of intensity at midday. The difference between the maximum and minimum is about 0·3 % of the mean intensity. No yearly variation has been established. The existence of irregular long period variations has been observed; also the Hofmann *Stösse*. D. H. F.

See also Abstracts 4539, 4566, 4671, 4734.

RADIATION, GENERAL THEORY.

4539. Irradiation in the Impact of Swift Particles. G. Racah. *N. Cimento,* 11. *pp.* 461–476, *July,* 1934.—Calculation is made of the probability of emission of a quantum of radiation in the impact of an electrified particle against a fixed nucleus. From this is deduced the energy lost by irradiation from the corpuscles that traverse matter. J. J. S.

4540. Theories of Light. H. M. Macdonald. *Science,* 80. *pp.* 233–238, *Sept.* 14, 1934. *Nature,* 134. *pp.* 482–483, *Sept.* 29, 1934. *Abstract. Presidential Address to the British Assoc., Aberdeen, Sept.,* 1934.—The classical theories of light from the time of Newton to that of Clerk Maxwell are described and a simplified theory of the propagation of a magnetic disturbance is sketched. G. C. McV.

4541. Intrinsic Energy of the Electron. V. Weisskopf. *Zeits. f. Physik,* 90. 11–12. *pp.* 817–818, *Sept.* 17, 1934.—A correction. [See Abstract 2874 (1934).]

REFLECTION. REFRACTION AND DISPERSION.

4542. Refractive Index of Thallium Vapour. G. Balin and S. Mandelstam. *Phys. Zeits. d. Sowjetunion,* 6. 1–2. *pp.* 159–162, 1934. *In German.*—Results for the refractive index of Tl at 5461 Å and 540° C. differ from those values given by McLennan [see Abstract 837 (1922)] and by Fermi and Rasetti [see Abstract 2537 (1927)]. W. R. A.

4543. Dispersion of NaCl and KCl in the Long-Wave Infra-Red. C. H. Cartwright and M. Czerny. *Zeits. f. Physik,* 90. 7–8. *pp.* 457–467, *Sept.* 4, 1934.—Measurements of refractive index and extinction coefficients on NaCl and KCl are extended in the region 120–240 μ. Values for the extinction coefficient agree with those of Czerny [see Abstract 802 (1931)]. NaCl and KCl show analogous variation of the optical constants. W. R. A.

4544. Wave-Mechanical Calculation of the Dispersion of Helium in the Ground State. H. Körwien. *Zeits. f. Physik,* 91. 1–2. *pp.* 1–36, *Sept.* 17, 1934.—In order to calculate the dispersion of helium in the ground state, the dispersion strengths (*i.e.,* the F-values) for the discrete and the continuous spectrum are determined, a Hylleraas eigenfunction (1st and 2nd approximation) being employed for the ground state. The eigenfunctions of the P states and the continuum were approximated by the hydrogen eigenfunctions, the more exact Hylleraas eigenfunction only being used for the correction of the first two P states. To the second (corrected) approximation the F-sum $\sum_k F_{k1}$ has the value 0·456. To the second approximation the F-integral $\int_0^\infty (dF/dx)\cdot dx$ gives 1·56. The requirement that $\sum_k F_{k1} + \int_0^\infty (dF/dx)\cdot dx$ must equal 2 is satisfied (in the second, corrected, approximation) to about 3 %. With the help of these results, the dispersion curve is calculated from 2303 to 6438 Å. Whilst the dispersion strengths of the discrete and continuous spectra are in the ratio 1 : 3·4, the ratio of their contributions to the dispersion is 1 : 1. A difference of 3 % between calculated and observed values is obtained. In this connection, and in continuation of Vinti's work, the dispersion contribution of the doubly excited states is calculated, and is found to be small, The calculated dielectric constant 1·00006953 is in good agreement with the experimental value 1·0000693. C. B. A.

4545. Optical Constants of Polished and Sputtered Molybdenum Surfaces. R. D. Summers. *J.O.S.A.* 24. *pp.* 261–263, *Oct.*, 1934.—The optical constants of molybdenum are determined by Drude's method for opaque films sputtered in air and in hydrogen, and for mirrors of massive metal, at wave-lengths 0·578μ, 0·546μ and 0·436μ. The indices of refraction and absorption, and the computed reflectivity are found to vary with the conditions of sputtering, and to be considerably less than for the massive metal. To eliminate any possible effect due to surface films formed by chemical action of the atmosphere, the final stage of polishing one of the bulk metal mirrors is carried out under kerosene, and the mirror is observed while immersed in kerosene. The results are not appreciably different when the same mirror is observed in air. AUTHOR.

4546. Zeiss Universal Theodolite. F. Ackerl. *Zeits. f. Instrumentenk.* 54. *pp.* 293–301, *Sept.*, 1934.—The paper describes different methods of using the theodolite for distance measurements, including the use of a Zeiss self-contained base, and analyses and compares the accuracy of the results. The accuracy in all cases is satisfactory and averages about 1 part in 2,000. W. D. W.

4547. Balloon Theodolite. W. Schnittger and H. Linke. *Zeits. f. Instrumentenk.* 54. *pp.* 311–317, *Sept.*, 1934.—The paper describes two theodolites for making observations on balloons from the ground and one for making observations from the balloon itself. These are of particular value in obtaining wind measurements by locating the position of captive balloons, and this application calls for special features in the design of the instruments. W. D. W.

See also Abstracts 4521, 4548, 4616, 4619.

SPECTROSCOPY.

4548. Evaluation of Prismatic Spectrum. H. Conrad-Billroth. *Zeits. f. Instrumentenk.* 54. *pp.* 301–305, *Sept.*, 1934.—A device is described in which a spectrum photograph can be viewed by a microscope and also translated in a direction parallel to the spectrum. By means of a mechanical lever the movement of the plate is magnified and measured relative to a curve drawn to correct for the prismatic dispersion. When a standard curve has been drawn from a known spectrum, a very satisfactory degree of accuracy can be obtained for unknown wave-lengths. W. D. W.

4549. Absorption Spectra by Excitation of Inner Electrons. Part VII. Rb Spectrum between 900 and 600 Å by Excitation of the $(4p)^6$ Level. (RbI^b). Comparison of the X-Ray Absorption of the $(4p)^6$ Level of Rb in the Solid State with the RbI^b Spectrum. H. Beutler. *Zeits. f. Physik*, 91. 1–2. *pp.* 131–142, *Sept.* 19, 1934.—40 absorption lines in the vapour of Rb lying beyond the series limit of the RbI spectrum (2967 Å) at 800 to 600 Å have been photographed against a helium continuum and measured. All the lines can be arranged in a term scheme (RbI^b) whose limits are the four terms $(4p)^5\ 5s$ of Rb^+, but the arrangement into individual series cannot be completed. The lines of longer wave-length lead to the terms ${}^2\mathrm{P}^{\circ}{}_{3/2,\ \frac{1}{2}}\ (4p)^5(5s)^2$, those of shorter wave-length to the terms from $(4p)^5\ 5s\ ms$ and $(4p)^5\ 5s\ md$. The absorption is thus due to the excitation of a $(4p)$ electron in the neutral Rb atom $(4p)^6\ 5s$, the valence electron remaining unaffected. The corresponding

X-ray spectrum is the $N_{II,\ III}$ absorption. Comparison of the transition of an electron from the $(4p)^6$ level to $5s$ in the neutral free atom with that of one from the same level in the Rb^+ ion of a crystal (Rb salt or metal) to a free level in the lattice shows that the energies involved in each case are about the same. [For Part VI see Abstract 1587 (1934).] C. B. A.

4550. Absorption Series of the Thallium Arc Spectrum (Tl I) and their Perturbation Terms 6s $(6p)^2$ $^4P_{1/2}$. H. Beutler and W. Demeter. *Zeits. f. Physik*, 91. 1–2. *pp*. 143–150, *Sept*. 19, 1934.—The absorption series of T*l* are photographed against a hydrogen continuum in a 1m. vacuum grating spectrograph. The series $^2P^\circ_{1/2} \rightarrow m\,d\,^2D_{3/2}$ is measured up to $m = 23$ and $^2P^\circ_{1/2} \rightarrow m\ s\ ^2S_{1/2}$ up to $m = 18$. The wave-lengths, wave-numbers, term values and effective quantum numbers are tabulated. A line at 2211·42 Å not belonging to these series causes a perturbation in the $m\ s\ ^2S_{1/2}$ series very close to $m = 10$. The quantitative course of the perturbation in the neighbouring terms cannot be represented by a formula of the type proposed by Langer. The line is the transition $(6s)^2\ 6p\ ^2P^\circ_{1/2} \rightarrow 6s\ (6p)^2\ ^4P_{1/2}$ of the T*l* I^b spectrum. C. B. A.

4551. Spectrum of Trebly Ionised Mercury. T. S. Subbaraya. *Indian Acad. Sci., Proc.* 1*A*. *pp*. 39–43, *July*, 1934.—The wave-length data of Carroll, Bloch, Déjardin and Ricard have been used. Constant wave-number differences for lines in the visible and near ultra-violet were looked for in Carroll's values and the fundamental multiplets of Hg IV were found. Classified tables are given. F. S.

4552. Intensities of Prohibited Lines in the Spectra of Alkali Metals. E. Rosa. *N. Cimento*, 11. *pp*. 380–389, *June*, 1934.—Using photographic photometry, the intensities of lines in the prohibited series $2p$–mp of the alkalis Li, Na, K and Rb were measured. Emission was obtained by introducing the powdered salts into a carbon arc, different densities of vapour being obtained by varying the arc current and the quantity of alkali salt used. With two exceptions the lines of the series decreased in intensity as m increased, and the results fit satisfactorily into the theory. An estimate of the intensity of the ionic electric field, which induces the emission of the prohibited lines, gave a value of the order of 10^4 volts/cm. W. S. S.

4553. Hyperfine Structure of Hg II. B. Venkatesachar and L. Sibaiya. *Indian Acad. Sci. Proc.* 1*A*. *pp*. 8–13, *July*, 1934.—A low-density long column arc was used to excite 3984 Å, while a hollow kathode of Mo in a He atmosphere was used for 2847 and 2262 Å. With the latter source the correct components of 4078 Å were found. The line 3984 Å was examined with a Fabry-Perot étalon, and the other with quartz Lummer plates. The observed structures are discussed in relation to theory. F. S.

4554. Specific Isotope Effect in the Hyperfine Spectrum of the Lead Atom. Beryl H. Dickinson. *Phys. Rev.* 46. *pp*. 598–604, *Oct*. 1, 1934.—A calculation by the method of Hughes and Eckart is performed for the specific isotope separation of Pb^{206} and Pb^{208} levels for terms arising from the $6p^2$, $6p7s$, $6p6d$, $6p7d$ and $6p8s$ configurations. The electron wave functions used are an ortho-normal set having the effective nuclear charge as parameter. From the perturbation calculation a double sum is obtained. Slater's method of sums is used to remove the degeneracy existing in the magnetic quantum number. The double sums for the various configurations of lead are found to contain a great number of terms which are common for all configurations and only a few terms which differ for the various configurations. These terms which are different for the various configurations are calculated and summed to obtain a "net specific isotope separation." It is found that an effective nuclear charge of only about 55 is necessary to make this net specific isotope separation equal to the observed isotope separation. A small variation from term to term of the same configuration requires that some other effect also be postulated. An upper limit argument for the specific isotope separation leads to a result of the order of thousands of wave numbers. This is shown to result from the vast number of terms in the double sum. It is not to be expected that this high upper limit for the separation would be approached by the actual separation. A set of wave functions which would be accurate enough to permit evaluating and subtracting the double sums does not seem obtainable. AUTHOR.

4555. Nuclear Mechanical Moment of Cobalt. K. R. More. *Phys. Rev.* 46. *pp.* 470–473, *Sept.* 15, 1934.—The hyperfine structure of the lines λλ4191, 4234, 6082, 6231, 6450 and 6592 of the arc spectrum of cobalt has been studied. The number of components and the interval ratios give a value of $I = 7/2$. The nuclear magnetic moment is estimated to be of the order of 2 to 3 small magnetons. AUTHOR.

4556. Nuclear Magnetic Moment of Lanthanum. O. E. Anderson. *Phys. Rev.* 46. *pp.* 473–476, *Sept.* 15, 1934.—The hyperfine structure of some 25 lines has been investigated in order to determine the absolute overall widths of each member of the $5d^26s\ {}^4F$ levels. From these a nuclear *g*-factor of 0·719 and a magnetic moment of 2·5 small magnetons have been computed. The Landé interval rule applied to the hyperfine structure of a three-electron configuration was found to hold. It was found that the interaction energy between the *s* electron and the nucleus as given by the Bacher-Goudsmit equations is not sufficient to account for the observed intervals but that the interaction energy between the *d* electrons and the nucleus must also be considered. [See Abstract 2892 (1934).] AUTHOR.

4557. Nuclear Magnetic Moments and Their Origin. A. Landé. *Phys. Rev.* 46. *pp.* 477–480, *Sept.* 15, 1934.—The origin of the nuclear moments is in most cases one proton or one neutron only. The analysis of hyperfine structure leads to the following magnetic moments: proton $\sim 2\cdot0$ magnetons and neutron $\sim -0\cdot6$ magneton. AUTHOR.

4558. Nuclear Magnetic Moments from the Polarisation of Resonance Radiation, Sodium, $3^2S_{1/2} - 3^2P_{3/2,\,1/2}$. L. Larrick. *Phys. Rev.* 46. *pp.* 581–583, *Oct.* 1, 1934.—The polarisation of sodium *D*-line resonance radiation excited by plane-polarised light in a magnetic field parallel to the electric vector of the exciting light increases from 16·5 % in zero field to almost 50 % in a field of 300 gauss as a consequence of the Paschen-Back effect of the hyperfine structure. The experimental results are well fitted by a curve calculated with $A(3^2P_{3/2}) = 7\cdot45 \times 10^{-4}$ cm^{-1} and $\tau(3^2P_{3/2}) = 1\cdot64 \times 10^{-8}$ sec. These results are for a nuclear moment of $3/2(h/2\pi)$ which was at first thought to give too low zero field polarisation (15·27 %). The higher polarisation is the effect of proximity of hyperfine levels in $3^2P_{3/2}$. AUTHOR.

4559. Nuclear Magnetic Moments from the Polarisation of Resonance Radiation, Sodium, $3^2S_{1/2} - 4^2P_{3/2,1/2}$. A. Ellett and N. P. Heydenburg. *Phys. Rev.* 46. *pp.* 583–589, *Oct.* 1, 1934.—The polarisation of sodium $3^2S_{1/2} - 4^2P_{1/2,\,3/2}$ (λ3303 Å) resonance radiation excited by unpolarised light has been measured as a function of the intensity of a magnetic field applied parallel to the direction of the incident light beam.

Detailed Paschen-Back effect calculations have been carried out for the hyperfine multiplet which constitutes a $^2S_{1/2}$–$^2P_{3/2}$ transition for a nuclear moment of $3/2(h/2\pi)$. From the fitting of the observed polarisation field strength curves we find the hyperfine structure separation constant for $4^2P_{3/2}$ to be $1{\cdot}87 \pm 0{\cdot}05 \times 10^{-4}$ cm^{-1}. The polarisation field strength curve shows very clearly the effect of proximity of hyperfine levels in $4^2P_{3/2}$.
AUTHORS.

4560. Calculation of the Optical Terms, in particular the Ionisation Potentials, of Divalent Metals using Fermi's Statistical Potential. U. Fano. *Accad. Lincei, Atti*, 20. *pp.* 35–39, *July*, 1934.—The Fermi statistical potential field is first modified to allow for the fact that when the optical electron is removed the atom rest corresponds to a simple ion rather than to a neutral atom of atomic number less by unity, as originally assumed. Calculations of the Rydberg correction for S terms as a function of the atomic number show a slightly better agreement with the experimental values than Fermi's original curve. For divalent metals there are two electrons either of which may function as the optical electron. A further refinement of the calculation to take account of this fact, yields an improved agreement for some metals. W. S. S.

4561. Spectral Multiplets Belonging to Configurations of the Type d^k m*s* and d^k m*s*n*s*. R. A. Merrill. *Phys. Rev.* 46. *pp.* 487–501, *Sept.* 15, 1934.—The Dirac vector model, as considered by van Vleck [see Abstract 2036 (1934)] has been applied to calculate the energy values of configurations of the type d^k m*s* and d^k m*s*n*s*, in cases where the d^k core conforms to Russell-Saunders coupling. The spin-orbit energy is not assumed small compared to the electrostatic energy coupling d^k to m*s* or d^k to n*s*. Johnson's formulæ for the four vector problem have been used to set up a general secular determinant for configurations of the type d^k m*s*n*s*. The special cases where d^k m*s*n*s* may be treated as a three vector problem or as a case of Russell-Saunders coupling are also considered. The following multiplets have been examined : Y I, $4d(^2D)5s6s$; Cu I, $3d^9(^2D)4s5s$; Zr I, $4d^2(^3F)5s6s$; Ni I, $3d^8(^3F)4s5s$; Co I, $3d^7(^4F)4s5s$; Fe I, $3d^6(^5D)4s5s$; and Ti I, $3d^2(^3F)4s6s$. The exchange integrals are considered as parameters and chosen to give the best fit with experimental data. The agreement with experiment for d^k m*s*n*s* is better, as it ought to be, with the four vector problem (L_d, S_d, s_m, s_n) than with the three vector problem (L_d, S_{d+m}, s_n) which in turn agrees better with experiment than does the two vector problem (L_d, S_{d+m+n}), the case resulting from the assumption of Russell-Saunders coupling. Configurations d^k m*s* (other than Houston's singlet-triplet case) have been examined as a three vector problem (L_d, S_d, s_m). Some examples treated are : Ti II, $3d^2(^3F)5s$; Ni II, $3d^8(^3F)5s$; Co I, $3d^8(^3F)5s$; Co I, $3d^8(^3F)4s$; Pd II, $4d^8(^3F)6s$; Fe I, $3d^7(^4F)5s$; Co II, $3d^7(^4F)5s$.
AUTHOR.

4562. Fifty-Three Electron Spectra of Cæsium and Barium : Cs III and Ba IV. M. Ambrosia Fitzgerald and R. A. Sawyer. *Phys. Rev.* 46. *pp.* 576–580, *Oct.* 1, 1934.—The separations of the lowest levels $5s^25p^5$ ^{2}P of the Cs III and Ba IV spectra have been predicted and observed. In the case of Cs III, the prediction was made from the s^2p^5p levels of Cs II by use of Shortley's equations. The separation as found is 13,870 cm^{-1} and several combinations of the terms with higher levels were located. The ^{2}P separation for Ba IV was estimated by the irregular doublet law and located from the data as 17,830 cm^{-1}. New data were obtained for cæsium by use of the vacuum spark, for barium by the vacuum spark and the condensed discharge in helium. The more complete data for barium enabled the location of a group of terms which combine both with the (s^2p^5) ^2P terms and also with a higher group of terms allowing the classification of about fifty lines in this spectrum. AUTHORS.

4563. Application of the Dirac Vector Model to the d^4 Configuration. M. Ostrofsky. *Phys. Rev.* 46. *pp.* 604–607, *Oct.* 1, 1934.—Formulæ for the energies of multiplets belonging to d^4 are computed by the use of the vector model as developed by van Vleck and Serber. Since insufficient data were available for d^4, the configuration md^4ns was used to check the formulæ against experiment. Even here the data are rather meagre. In order to obtain out of the above configuration the proper energies of the multiplets arising from d^4 alone, it was necessary to subtract from it the exchange energy between the s electron and the d^4 " core." The agreement with experiment is, at best, only fair, perhaps because of perturbations from neighbouring levels. AUTHOR.

4564. Absorption Spectrum of Tin Sulphide. K. Butkow and W. Tschassowenny. *Zeits. f. Physik,* 90. 11–12. *pp.* 815–816, *Sept.* 17, 1934. The absorption spectrum of SnS vapour has been investigated in the region 3800 to 2530 Å. There are two band systems for which the formulæ for the heads are given. The oscillation quantum determined experimentally agrees with the theoretically calculated values. F. S.

4565. Band Spectrum and Structure of the CP-Molecule. H. Bärwald, G. and L. Herzberg. *Ann. d. Physik,* 20. 6. *pp.* 569–592, *Sept.,* 1934.—In this paper is given the complete oscillation and rotation analysis of the band system between 4400 and 2900 Å attributed to the CP-molecule. A new, weaker system of the same molecule has been found between 4400 and 5000 Å. The two systems have the same upper level and are due to a $^2\Sigma^\times - {}^2\Sigma$ transition in the near ultra-violet and a $^2\Sigma^\times - {}^2\Pi$ transition in the blue-green. Accurate formulæ are given and values of the moment of inertia and nuclear distance are calculated. Comparison is made with the molecules SiN, CN, N_2^+, BO, CO^+ and AlO which have the same number of outer electrons. F. S.

4566. Infra-Red Absorption of Carbon Dioxide between 300° and 1100° K. C. Tingwaldt. *Phys. Zeits.* 35. *pp.* 715–720, *Sept.* 15, 1934. *From the Reichsanstalt.*—The absorption of the CO_2 band, $\lambda = 2{\cdot}7\mu$, is measured in dependence on temperature and layer thickness. Particular care is taken to exclude the influence of cold layer absorption from the experiments; the absorbing CO_2 was kept in uniformly heated quartz flasks contained in metal boxes which had been cleaned out by the passage of pure nitrogen. The emissive power of CO_2 layers at various temperatures between 300 and 900° C. is calculated from the experimental results, the values being tabulated and compared with those obtained by Schack in his pioneer experiments on the radiation energy of fire gases. The values are in excellent agreement at the higher temperatures. J. E. K.

4567. Near Infra-Red Absorption of Solutions of Hydroxides and Hydrolysing Salts. W. Gordy. *J. Chem. Phys.* 2. *pp.* 621–623, *Oct.,* 1934.—Absorption bands have been observed at $2{\cdot}60\mu$, $2{\cdot}30\mu$, $1{\cdot}81\mu$, $1{\cdot}30\mu$, $1{\cdot}22\mu$, $1{\cdot}04\mu$, $0{\cdot}87\mu$, $0{\cdot}79\mu$, $0{\cdot}75\mu$ and $0{\cdot}67\mu$ in aqueous solutions of hydroxides and hydrolysing salts. From the behaviour of the salt solutions the bands at $2{\cdot}60\mu$ and $1{\cdot}81\mu$ were found to be characteristic of the hydroxide molecule, while the band at $2{\cdot}30\mu$ was found to be characteristic of the OH ion. It was found that if the $2{\cdot}30\mu$ band, and the

$3 \cdot 65\mu$ and $5 \cdot 20\mu$ bands previously observed were considered as fundamentals, the remaining bands observed could be classified as harmonics. AUTHOR.

4568. Molecular Absorption of Mercury Vapour in Schumann's Region. N. Kremenewsky. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 237–241, *Aug.* 1, 1934. *In English.*—An investigation of the absorption spectrum of mercury vapour in Schumann's region is described. Steubing's bands appeared at 200° C. The bands converge very slowly. Their convergence limit appears to be at a wave-length shorter than 1900 Å. At 280° C. a further development of the absorption spectra was observed. In the region of 1750 Å a slight fall of intensities in the continuous spectrum took place. With rise of temperature this fall developed into a nearly symmetrical band with a maximum at 1755 Å. Over this band as a background, on the short wave-length side, diffusion bands similar to Steubing's appeared. Simultaneously several diffusion bands on the right of the absorption band at 1692 Å were observed. J. J. S.

4569. Suppression of Ozone Bands at Low Temperatures. Lucie Lefebvre. *Comptes Rendus,* 199. *pp.* 456–457, *Aug.* 13, 1934.—At the temperature of solid CO_2 the absorption spectrum is more "contrasty." Some bands are narrowed and others disappear. The narrowing and weakening effects allow the bands to be put in series, five of which are given. J. E.

4570. Absorption Spectra of Trivalent Bi and Sb Halide Vapours. K. Butkow. *Zeits. f. Physik,* 90. 11–12. *pp.* 810–814, *Sept.* 17, 1934.—The absorption of the vapours of BiI_3, $BiBr_3$, and SbI_3 was investigated in the region from 7000 to 2000 Å. The consideration of the boiling-point temperatures allows the investigated molecules to be attributed to the polar atomic combinations. The long-wave absorption maxima are connected with a photo-dissociation of the molecule with splitting off of the excited halogen atom. J. J. S.

4571. Spectrum of Chlorophyll. J. A. Prins. *Nature,* 134. *pp.* 457–458, *Sept.* 22, 1934.—The absorption spectra of chlorophyll *a* and *b* in alcohol solution are recorded. It is shown that the red band is not due to ionic absorption alone, but that an electron is also lifted to a higher level. With the help of observations of fluorescence, a qualitative attempt is made to attribute energy levels to the molecule. C. B. A.

4572. Molecular Spectra and Molecular Structure. H. Deslandres. *Comptes Rendus,* 199. *pp.* 393–397, *Aug.* 6, 1934.—A continuation of previous work [see Abstract 3308 (1934)]. The present paper deals with the molecules H_2, Li_2, C_2 and C_2H_2. Their characteristic frequency (from Raman or absorption spectra) and electronic data are tabulated, and the relation $\nu = qd_1/r^1s^1$ verified. W. R. A.

4573. Band Spectra of Aluminium Hydride and Aluminium Deutride. W. Holst and E. Hulthén. *Zeits. f. Physik,* 90. 11–12. *pp.* 712–727, *Sept.* 12, 1934.—The band spectra of AlH and AlD are investigated with particular regard to the isotope effects in the rotation and nuclear vibration terms. A difference is found between the mass ratio of AlH/AlD as given by the investigation and that calculated from the known atomic weights of H and D. This difference is explained in various ways, special consideration being given to the interaction between the motions of the electron and the nucleus. J. E. K.

4574. New Band Spectrum of Aluminium Hydride. W. Holst. *Zeits. f. Physik,* 90. 11–12. *pp.* 728–734, *Sept.* 17, 1934.—A new band spectrum of AlH is reported. The new system appears at a wave-length of 3380 Å and an analysis shows that it corresponds to a $^1\Pi^* \rightarrow {}^1\Pi$ transition. The lower $^1\Pi$ term is identical with the upper $^1\Pi$ term of the well-known $^1\Pi \rightarrow {}^1\Sigma$ system. The Λ-separation is found to be $\Delta\nu = 1{\cdot}29\ (j + \frac{1}{2})^2 - 0{\cdot}0163\ (j + \frac{1}{2})^4 - 0{\cdot}867 \times 10^{-4}\ (j + \frac{1}{2})^6$. An anomalous intensity distribution in the branches of the band is described. J. E. K.

4575. New $^1\Sigma^{***} \rightarrow {}^1\Pi$-System of Aluminium Hydride. W. Holst. *Zeits. f. Physik*, 90. 11–12. *pp.* 735–741, *Sept.* 17, 1934.—A new band spectrum $^1\Sigma^{***} \rightarrow {}^1\Pi$ of AlH is reported. The $^1\Pi$ term is the same as the $^1\Pi$ term in the previously known $^1\Pi \rightarrow {}^1\Sigma$ system. The termination of the band at $j = 20$ is explained as due to the predissociation of the $^1\Pi$ term. The intercombination band $^1\Sigma^* \rightarrow {}^1\Pi$ is again investigated and it is found that this band also comes to an abrupt termination arising from the $^1\Pi$ band. [See also Abstract 2903 (1934).] J. E. K.

4576. Absorption Spectra of Cobalt-Ethylenediamine-Halogen Complexes. M. L. Ernsberger and W. R. Brode. *Am. Chem. Soc., J.* 56. *pp.* 1843–1844, *Sept.*, 1934.—Compounds of the type $(CoEn_2X_2)X$, where X is halogen, have been prepared and their absorption spectra studied and analysed. A regular decrease in mean frequency difference corresponding to increase in the weight of the substituents was found. AUTHORS.

4577. Ultra-Violet Bands of Beryllium Chloride. W. R. Fredrickson and M. E. Hogan, Jr. *Phys. Rev.* 46. *pp.* 454–458, *Sept.* 15, 1934.—A band system in the near ultra-violet region (3468–3700 Å) is obtained by using a beryllium arc in an atmosphere of chlorine. Four heads are found for each band, the $^SR_{21}$ heads being about one-third as intense as the other heads. The system is due to a $^2\Pi - {}^2\Sigma$ transition with the $^2\Pi$ state an intermediate one between case **a** and case **b**. A complete rotational analysis is impossible but from the spacing of the lines in certain branches, $B' \cong 0{\cdot}8$ and $A/B \cong 31$. The isotope effect for chlorine is observed in − 1 and + 1 sequences and the $^SR_{21}$ head of the (0,0) band. From the heats of dissociation, it appears that the electronic excitation is due to the $^1D \rightarrow {}^1P$ transition in the Be atom. AUTHORS.

4578. Infra-Red Spectra of the Chlorine Derivatives of Ethylene. Ta-You Wu. *Phys. Rev.* 46. *pp.* 465–469, *Sept.* 15, 1934.—The infra-red absorption spectra of the molecules $C_2H_2Cl_2$, cis $C_2H_2Cl_2$, trans $C_2H_2Cl_2$, C_2HCl_3, C_2Cl_4 are studied in the region between 2 and 25μ. The difference of the spectra of the two symmetric isomers is shown. An attempt is made to analyse the absorption bands observed together with the Raman spectra into the fundamental vibrations of these molecules. AUTHOR.

4579. Rotational and Vibrational Structure of the Fourth Positive Bands of Carbon Monoxide. D. N. Read. *Phys. Rev.* 46. *pp.* 571–575, *Oct.* 1, 1934.—The rotational structure of twelve of the fourth positive bands of CO ($A\,^1\Pi - X\,^1\Sigma$) has been measured and analysed. The analyses of two bands are given. The values obtained for the rotational constants of the normal state are $B_0 = 1{\cdot}9170\ \text{cm}^{-1}$, $\alpha = 0{\cdot}01738\ \text{cm}^{-1}$. This is in disagreement with the result of infra-red band measurements, which give $B_0 = 1{\cdot}84$. The data obtained on the excited $A\,^1\Pi$ state are in complete agreement with the results of Ångstrom ($B\,^1\Sigma - A\,^1\Pi$) band studies. The higher value for B_0 for the normal state is verified by measurement of the 0 − 0 band of the ultra-violet system $B\,^1\Sigma - X\,^1\Sigma$. The recently reported predissociation of the B state is also observed in this band. New measurements are given of the fourth positive band heads below 2270 Å. A formula is given to represent all the known band heads, and from this a formula for band origins is obtained. AUTHOR.

4580. Infra-Red and Raman Spectra of Methyl Compounds. A. Adel and E. F. Barker. *J. Chem. Phys.* 2. *pp.* 627–629, *Oct.*, 1934.—An analysis of the resonance interaction between the vibrations ν_1 and $2\nu_4$ in the methyl halide molecules explains the appearance of the very intense extra band in the infra-red and Raman spectra of these molecules. This degeneracy is evidently characteristic of the methyl group. A number of molecules involving the methyl group and exhibiting the phenomenon of the extra band are listed. AUTHORS.

4581. Vibrational Spectrum of Water Vapour. L. G. Bonner. *Phys. Rev.* 46. *pp.* 458–464, *Sept.* 15, 1934.—The nonlinear triatomic molecule of the type XY_2 has been treated and the expression for the energy of vibration has been obtained when second, third and fourth powers of the coordinates are considered in the potential function. The higher powers of the coordinates have been introduced by the use of first and second order perturbation theory. A method has also been outlined for treating the more complicated types of kinetic energy expressions by a perturbation method. Using the results of this treatment there have been evaluated for the water molecule, from the known spectrum, the primary binding constants and vibration frequencies for infinitesimal amplitudes. Finally, a prediction of the infra-red vibration spectrum of the symmetrically substituted heavy water has been made. AUTHOR.

4582. Normal Frequencies of Vibration of Symmetrical Pyramidal Molecules AB_3 with Application to the Raman Spectra of Trihalides. J. B. Howard and E. B. Wilson, Jr. *J. Chem. Phys.* 2. *pp.* 630–634, *Oct.*, 1934.—The symmetrical pyramidal molecules AB_3 is treated by a general normal-coordinate method, six force constants being required. The convenience of the use of "symmetry coordinates" is illustrated in obtaining the formulæ for the normal frequencies for several types of potential functions. It is found that with two constants the central force treatment and valence force treatments fit the data equally well. The four constants K, H, K' and H' of the potential function

$$2V = K\Sigma_i \Delta R_i^2 + \tfrac{1}{2} H R_0^2 \Sigma_{ij}' \Delta a_{ij}^2 + K' \Sigma_{ij}' \Delta R_i \Delta R_j + 2H' R_0^2 (\Delta a_{12} \Delta a_{23} + \Delta a_{23} \Delta a_{31} + \Delta a_{31} \Delta a_{12})$$

for certain trihalides are obtained from Raman data. The interatomic distances calculated using these values of K in the empirical relation found by Badger for diatomic molecules agree with the distances obtained by other methods to within about 0·1 Å. AUTHORS.

4583. Absorption of Light in Organic Compounds. N. Q. Chako. *J. Chem. Phys.* 2. *pp.* 644–653, *Oct.*, 1934.—An attempt is made to evaluate from published measurements the total strength and width of absorption bands of organic compounds, and to correlate that with the nature of the solvent and the constitution of the substance. None of the quantities which can be considered from the theoretical standpoint is found to remain constant. AUTHOR.

4584. Magnetic Dipole Radiation and the Atmospheric Absorption Bands of Oxygen. J. H. van Vleck. *Astrophys. J.* 80. *pp.* 161–170, *Oct.*, 1934.—It is shown that the atmospheric bands of oxygen are best interpreted as magnetic dipole radiation rather than as ordinary dipole or quadripole radiation. Then the upper state can be $^1\Sigma_g^+$, as demanded by configuration theory, and still one can apply Schlapp's intensity formulæ, which agree with experiment. Also Childs and Mecke's estimates of absolute intensities favour the magnetic dipole hypothesis. Some general remarks are included concerning the role of magnetic dipole radiation in molecular spectra. Certain satellite bands in OH which contradict the usual selection rules are most likely due to this type of radiation. Intensity formulæ are given for the $^3\Sigma - {}^1\Delta$ oxygen band at about 12,600 Å, which also arises from the magnetic dipole terms. AUTHOR.

4585. Absorption and Fluorescence Spectra of Hydrocarbons with Two Benzene Rings. R. Titeica. *Comptes Rendus*, 199. *pp.* 458–460, *Aug.* 13, 1934.—An attempt to find the vibration frequencies associated with the benzene ring, in compounds other than those already studied by Henri and others. The absorption spectrum of dibenzyl gives a series of bands showing a frequency difference of 441 cm^{-1}. Diphenylmethane and diphenyl also show this frequency in their fluorescence spectra. The other known characteristic frequency difference, 1450 cm^{-1}, also appears. As the lower frequency never appears in Raman spectra it is suggested that since 1450 is roughly three times the lower frequency, the bands might be grouped in three series giving only the higher frequency interval. J. E.

4586. Stark Effect in Helium. B. Kullenberg. *Zeits. f. Physik*, 90. 9–10. *pp.* 567–575, *Sept.* 6, 1934.—The lines 4686 Å and 3203 Å have been investigated afresh and have been resolved into simple components. The values obtained are compared with those given by the formula of Epstein and Gordon. Further measurements of the parhelium groups 2S — 8Q and 2S — 9Q have also been made. F. S.

4587. Raman Effect in Organic Esters. G. R. Paranjpe and K. S. Savanur. *Indian Journ. Phys.* 8. 6. *pp.* 503–520, *June*, 1934.—The following liquids were investigated: methyl-, ethyl-, propyl-, butyl-, and iso-amyl-formates and acetates; methyl- and ethyl-propionates and butyrates. An attempt is made to ascribe various shifts to particular groupings within the molecules; in particular 630, 1030 and 1730 cm^{-1} have been ascribed to the $\mathrm{O} = \overset{|}{\mathrm{C}} - \mathrm{O} -$ configuration present in all ten compounds. The values obtained are compared with the results of infra-red spectra, where available. Values of the elastic stretching forces are calculated for the $\mathrm{C{-}O}$ and $\mathrm{C{=}O}$ linkages. The influence of homology and isomerism on the spectra are treated in considerable detail. A. C. M.

4588. New Frequencies in the Raman Spectrum of Ethyl Alcohol. G. Bolla. *Zeits. f. Physik*, 90. 9–10. *pp.* 607–622, *Sept.* 6, 1934.—In the Raman spectrum of ethyl alcohol, excited by Hg 2537 Å, 56 frequencies are found. Of these 14 (or 17) cannot be regarded as simple combinations of others, and are taken to be fundamentals. The fundamentals include the most intense of the frequencies previously known, together with the new fundamentals 3632·0, 3359·3, 3240·3, 1617·8, 814·2 and 256·6 cm^{-1}. Analogies to the spectrum of water lead to the conclusion that these new frequencies (with the probable exception of 814·2 cm^{-1}) are connected with the hydroxyl group of the molecule. L. A. W.

4589. Raman Frequencies of Sodium Nitrate in Different States. I. R. Rao. *Zeits. f. Physik*, 90. 9–10. *pp.* 650–657, *Sept.* 6, 1934.—This substance was investigated as a solid, in solution in water, and in a molten state. Lines were obtained in the first state at 726, 1071, 1389 and 1670 cm.$^{-1}$; in the second at 721, 1049, 1361 and 1683 cm.$^{-1}$; in the third at 1053 cm^{-1} only. The lines due to the solution were diffuse. The crystals were examined at 40° and 300° C. and no change was found. The 1049 line in the solution was more diffuse at 100° C. than at 40° C., and the maximum was moved slightly nearer the exciting line. These changes are explained by consideration of the position of the N atom relative to the three O atoms. A considerable broadening of the exciting lines is observed, from which it is deduced that the nitrate ion is strongly anisotropic, indicating that the NO_3^- group is very nearly plane. A. C. M.

4590. Structure and Polarisation of Raman Bands of Water. . R. Rao. *Zeits. f. Physik*, 90. 9–10. *pp.* 658–662, *Sept.* 6, 1934.—Raman bands of water have been observed with apparent fine-structure. This is found to be spurious, and due to interference-effects in the quartz parts of the spectrograph employed. Similar anomalous effects are found in polarisation experiments on the Raman bands of water where a quartz instrument is used, and it is pointed out that this danger exists in all such experiments where polarised light is used with a quartz spectrograph.

A. C. M.

4591. Raman Spectra and Molecular Constants of PF_3 and PH_3. D. M. Yost and T. F. Anderson. *J. Chem. Phys.* 2. *pp.* 624–627, *Oct.*, 1934.—The Raman frequencies of $PF_3(l)$ were found to be $\omega_1(1)$, 890 cm^{-1}; $\omega_2(1)$, 531 cm^{-1}; $\omega_3(2)$, 840 cm^{-1}; and $\omega_4(2)$, 486 cm^{-1}, indicating a regular pyramid structure of the molecule. Three frequencies were observed for $PH_3(l)$: 2306 cm^{-1}, 1115 cm^{-1} and 979 cm^{-1}. With the aid of electron diffraction data the standard virtual entropies of $PF_3(g)$, $PCl_3(g)$, $AsF_3(g)$, and $AsCl_3(g)$ at 25°C are calculated to be 64·2, 74·7, 69·2, and 78·2 cal./deg., respectively; that of $PH_3(g)$ is estimated to be 50·5 cal./deg. These data lead to the following free energies of formation at 25°C: $AsCl_3(g)$, − 62,075 cal.; $PH_3(g)$, 2750 cal.; $PCl_3(g)$, − 62,220 cal.

AUTHORS.

4592. Raman and Ultra-Violet Absorption Spectra of Metal Carbonyls and Alkyls. A. B. F. Duncan and J. W. Murray. *J. Chem. Phys.* 2. *pp.* 636–643, *Oct.*, 1934.—The Raman spectra of nickel carbonyl, iron penta-carbonyl, lead tetramethyl, and lead tetraethyl and the ultra-violet absorption spectra of nickel carbonyl, lead tetramethyl and lead tetraethyl have been studied. The symmetry number of nickel carbonyl has been calculated. The vibrations of a mechanical model of a plane XY_4 molecule have been studied. The correlation of the observed Raman lines with modes of vibration is discussed. It is concluded, from the observed spectrum and the vibrations shown by the mechanical model, that nickel carbonyl has a plane rather than a tetrahedral structure. [See Abstract 2453 (1934).] AUTHORS.

4593. Astigmatic Spectrograph with Prism-Objective. D. Chalonge and E. Vassy. *Rev. d'Optique*, 13. *pp.* 113–126, *April*, 1934.—The optical parts consist of a Cornu prism of quartz and a quartz-fluorite objective of 50 cm. focus and 45 mm. aperture. In order to extend the length of line, astigmatism is introduced by inclining the objective about an axis parallel to the apex of the prism. The instrument has been used to study the absorption of oxygen in the region 2300–2700 Å, a hydrogen tube at 1850 m. distance having been photographed. Several stellar spectra have also been studied. F. S.

4594. Spectrographic Detection and Estimation of Minute Quantities of Impurities in Copper. M. Milbourn. *Inst. of Metals, J.* 55. [6 *pp.*], 1934. *Advance Copy.*—An accurate and convenient method is described for the detection and estimation of small quantities of bismuth, arsenic, lead, iron, nickel, silver, antimony, and tin in copper. Details of technique, sensitivity, and line intensity comparisons are given. AUTHOR.

4595. " Synthetic Spectrum " Analysis and Estimation of Small Quantities of Bismuth in Copper. D. M. Smith. *Inst. of Metals, J.* 55. [9 *pp.*], 1934. *Advance Copy.*—A method has been devised for the production of " synthetic " spectra as standards for comparison, the spectrum of a standard alloy being exactly superimposed on that of the pure metal which forms the main constituent. The total time of the two exposures is equal to the normal time of exposure of a sample which is being analysed, and a series of spectra is obtained in which the impurity lines show a systematic increase in intensity. While the method was originally applied to the checking of the reliability of standard samples, it can be used for the quantitative determination of impurities in metals, once the standard calibration curve has been obtained. The application to the determination of 0·0001 to 0·004 per cent. of Bi in Cu is described. AUTHOR.

4596. Spectrographic Analysis of Aluminium Alloys. E. H. S. van Someren. *Inst. of Metals, J.* 55. [8 *pp.*], 1934. *Advance Copy.*—The paper describes the technique of analysing Al alloys by means of their spark spectra in the ultra-violet, using the method of internal standards. Tables are given for the estimation of Cu, Zn, Fe, Si, Mn, Mg, Ni, Sn and Cd ; and also for the detection of Pb, Sb, Cr, Ti, and Bi. AUTHOR.

4597. Short-Wave Infra-Red Spectrum of Silicates. K. Wirtz. *Phys. Zeits.* 35. *pp.* 649–651, *Aug.* 15, 1934.—The infra-red reflection spectrum of silicates is dealt with from the standpoint of their crystal structure. The spectra show that certain minerals contain metal-oxygen complexes in conjunction with SiO_4 tetrahedra. These complexes are discussed. W. R. A.

4598. Spectroscopy and Thermodynamics. H. Zeise. *Zeits. f. Elektrochem.* 40. *pp.* 662–669, *Sept.*, 1934.—A number of corrections are given with reference to the recently published general review by the author [see Abstract 222 (1934)]. Supplementary matter is also added in connection with the molecules H_2, HI, Br_2, HBr, I_2, CO, N_2, H_2O, C_2H_6 and C_6H_6. L. A. W.

See also Abstracts 4386, 4508, 4511, 4515, 4526, 4527, 4637, 4703.

VISION.

4599. Colour Recognition Tests for Signal Glasses. L. S. Ornstein, J. G. Eymers and D. Vermeulen. *K. Akad. Amsterdam, Proc.* 37. 7. *pp.* 385–391, 1934. *In German.*—Observers adapted to a low brightness level were asked to name the colour of a small monochromatic test spot seen against a dark background, using one of the colour names : red, orange, yellow, green, blue, white, grey, doubtful, nothing. Twenty-one wave-lengths and five intensities of the test object were studied, and the results are tabulated to show for each case, the percentage number of observers who applied each of the colour names. Application of the data to the problem of signal glasses is deferred until the effects of saturation, adaptation and surround brightness have been studied. W. S. S.

4600. " Seeing " by Coloured Light. W. Arndt. *Zeits. f. techn. Physik,* 15. 8. *pp.* 296–301, 1934.—Reviews what is known of the visual capacities—visual acuity, contrast sensitivity, speed of vision, accommodation, etc.—determined (*a*) for the white light given by incandescent lamps, (*b*) for monochromatic or polychromatic light given by gas-discharge tubes. A higher acuity is obtainable with the latter type of light, but for other visual capacities no difference has been observed. The advantage of coloured light depends on the precise conditions under which " seeing " takes place. W. S. S.

4601. Liminal Brightness Increment for White Light for Different Conditions of the Foveal and Parafoveal Retina. W. S. Stiles and B. H. Crawford. *Roy. Soc., Proc.* 116B. *pp.* 55–102, *Sept.*, 1934.—Measurements were made of the smallest perceptible difference of brightness T between a white test spot and its immediate surround, for an eye adapted to brightness distributions of the following types : uniform field brightness, uniform surround brightness with dark centre field, glare source (white or coloured) at 3° or 6° above the test spot. The test spot was viewed either by direct (foveal) vision or by indirect (5° parafoveal) vision. In the latter case, curves showing the variation of T with brightness level indicated a change of law in the neighbourhood of 0·001 c./sq.ft. corresponding to the transition from cone to rod vision. For foveal vision, the effect of a glare source on the value of T was approximately the same whatever the colour of the glare source. For parafoveal vision in the rod range, T was raised most by a blue, least by a red glare source. The variations of T with the size and period of exposure of the test spot, were also studied. W. S. S.

X-RAYS.

4602. Production of X-Rays by Fast Mercury Ions. W. M. Coates. *Phys. Rev.* 46. *pp.* 542–548, *Oct.* 1, 1934.—A study has been made of the production of soft X-rays (4 to 9 Å) by Hg ions having energies up to 2·38 million electron volts. The ions were accelerated by the method of Sloan and Lawrence [see Abstract 4675 (1934)]. It has been shown conclusively that the X-rays are actually produced by the ions and not by electrons. Through absorption measurements in Al and in air the wave-length of the radiation has been determined for the following targets : Al, S, Br, Mo, Ag, Sn and Pb. No radiation could be detected from Li, B, C, O, Na, Ni or Cu. The wave-lengths were characteristic of the target in the case of Al, S, Br, Pb and probably Mo. The radiations from Sn and Ag were not characteristic either of the target or of Hg. The variation in X-ray intensity as a function of the energy of the ions has been studied for targets of Pb, Br, Mo, Ag and Al. The X-ray intensity is found to increase very rapidly with the energy of the ions. No radiation could be detected from Br, Mo or Al when the ions had energies less than 700 kV, nor from Pb Ag when the ions had energies less than 400 kV. It is found that at least one in every 2000 Hg ions produces an X-ray quantum when Ag is bombarded. The ions in this case had 2·38 million electron volts and produced 2600 volt quanta. A theory is proposed to explain the excitation of X-rays by positive ions, wherein it is assumed that the ion and the target atom temporarily form a quasi-molecule. Loss of some of the inner electrons by one of the atoms as the molecule breaks up necessitates refilling of the empty levels and consequent radiation. Support for this theory is afforded by the agreement between the calculated and the experimental values for the minimum energy necessary for excitation. AUTHOR.

4603. Compton Effect for Bound Electrons. W. Franz. *Zeits. f. Physik*, 90. 9–10. *pp.* 623–649, *Sept.* 6, 1934.—The Compton effect for bound electrons is studied by representing the bound electron in a given initial state as a wave packet of free electrons, to each plane wave component of which the Klein-Nishina formula is applied. In this way an approximate formula for the intensity of Compton scattering for bound electrons is derived from which it appears that for scattering of very hard rays at small angles, the scattered intensity is less for bound than for free electrons, a result contrary to that found by Casimir [see Abstract 4253 (1933)]. W. S. S.

4604. Effect of Pressure on the Intensity of X-Rays Scattered from Nitrogen at Small Angles. G. G. Harvey. *Phys. Rev.* 46. *pp.* 441–445, *Sept.* 15, 1934.—It is found that at small angles the scattering from a " permanent " gas diminishes due to intermolecular interference. The scattering curves at various pressures closely resemble those of a liquid or solid. It is concluded that this is due to the closeness of the scattering centres rather than to any preferred orientation of molecular groups since it is unlikely that such groups would be present in a gas so far from the liquid state. AUTHOR.

4605. Atom Form-Factors. B. v. Sz. Nagy. *Zeits. f. Physik*, 91. 1–2. *pp.* 105–110, *Sept.* 19, 1934.—On the basis of the wave-theory—corrected atom—model of Lenz and Jensen, deduces an arithmetical method for determining atom form-factor curves for any atoms and ions with a sufficient number of electrons ; the results being closer approximations than those provided by the Thomas formula. A. D.

4606. Atom Factor of Beryllium. W. Ehrenberg. *Zeits. f. Krist*, 89. 2. *pp.* 185–191, *Oct.*, 1934.—Determination of the F-curve for metallic Be. Confirmation of the Hartree calculus for the atom factor. Influence of extinction on the intensities with a powder-preparation. The values of F agree better with those deduced from He atoms than from He ions. A. D.

4607. Absorption of Hard X-Rays in Lead. A. Alichanjan and M. Kosman. *Zeits. f. Physik*, 90. 11–12. *pp.* 779–787, *Sept.* 17, 1934.—Absorption coefficients in the wave-length region from 80 to 24X were determined by comparison of absorption curves in lead and water with previous filtering through lead. It is pointed out that the value obtained is not consistent with those of Herrmann and Jaeger and Nahmias ; the cause of the discrepancy lies in this, that these investigators ascribe the absorption coefficients found by them to the boundary wave-length of the continuous spectrum, which however, even with strong filtering, deviates considerably from the effective wave-length. On making allowance for this the results of those observers agree fairly well with those of the authors. The values of μ, the absorption coefficient obtained and the corresponding wave-lengths are given in the following table :

λ in kV	206	229	308	338	368	378	382	400	454	460	495
μ cm.$^{-1}$	8·8	5·8	4·3	3·5	3·0	3·5	3·4	2·7	2·2	2·4	1·9

J. J. S.

4608. Natural Width of X-Ray Spectral Lines. L. Pincherle. *Accad. Lincei, Atti*, 20. *pp.* 29–35, *July*, 1934.—The object of this paper is to justify theoretically the results of recent experiments on the width of the spectral lines of X-rays on the basis of quantum mechanics and with the hypothesis that deals exclusively with natural width. J. J. S.

4609. Continuous Radiation Due to Fast Electrons. F. Sauter. *Ann. d. Physik*, 20. 4. *pp.* 404–412, *July*, 1934.—The author's method of working out the mathematics of the continuous X-ray spectrum, in which the electrons are represented by modified plane waves [see Abstract 239

(1934)] is applied to the calculation of the intensity distribituon at the short-wave end of the spectrum. J. T.

4610. Estimation of Small Differences in X-Ray Wave-Lengths by the Powder Method. A. H. Jay. *Phys. Soc., Proc.* 46. *pp.* 713–720, *Sept.* 1, 1934.—It has been found possible by the use of a microphotometer to determine accurately the positions of lines at high angles of reflection on a powder photograph. With a powder photograph of clear colourless quartz taken with copper Kα- radiation, the distance apart of the two component lines of a well-resolved doublet was measured to within 0·0002 cm. The measurements were then corrected for systematic errors —eccentricity of specimen, absorption of the radiation in the specimen, and divergence of the X-ray beam. The wave-length difference $(\lambda_2 - \lambda_1)$ was finally calculated in terms of the given wave-length λ_1. The value of $(\lambda_2 - \lambda_1)$ for copper Kα- radiation is given as 3·833 X. AUTHORS.

4611. Simple Method of Photometering X-Ray Photographic Spectra. A. Mutscheller. *Am. J. of Roentgenology and Radium Therapy*, 32. *pp.* 384–387, *Sept.*, 1934.—X-ray voltages are determined by measurement of the minimum wave-length of the emitted spectra and therefore it is of importance to have a simple method of determining this, free from error. A photoelectric apparatus is described to determine photometrically the minimum wave-length. The apparatus is described in detail and illustrated, together with typical measurements. The instrument is also suggested as being suitable for the photometric measurement of X-ray films. B. J. L.

4612. Primary X-Ray Method of Chemical Analysis. E. Wainer. *Am. Chem. Soc., J.* 56. *pp.* 1653–1657, *Aug.*, 1934.—It is shown that a definitive standardisation of the variables of the spectrograph, photographic plate, analytical procedures, etc., must be adhered to rigidly in order to obtain comparable results of analytical worth. The use of log time-density was found to be a more suitable function for defining the plate characteristic for X-ray exposures than the usual log intensity-density. An absolute method of X-ray spectroscopic estimation from predetermined curves will be suitable for analysis provided a filament which gives a uniform emission of electrons be used. AUTHOR.

4613. Direct-Reading, Two-Crystal X-Ray Spectrometer. F. K. Richtmyer and S. W. Barnes. *Rev. Sci. Instruments*, 5. *pp.* 351–355, *Oct.*, 1934.—A two-crystal X-ray spectrometer is described in which wave-lengths are read directly to 0·01 X.U. from the drum of a precision micrometer screw. Methods of initial adjustment are given in brief outline and as sample results there are shown the close lines Lγ_2 and Lγ_6 of Au (79); and the "foot" of Lα_1 of the same element, with the accompanying satellites, the intensity of which is found to be 0·060 of that of Lα_1. AUTHORS.

4614. Portable Vacuum X-Ray Spectrograph. T. H. Osgood. *Rev. Sci. Instruments*, 5. *pp.* 368–369, *Oct.*, 1934.—The spectrograph described is for use in the soft X-ray region and the complete instrument (including X-ray tube) weighs 10 kg. For plate loading the whole instrument is detached from the pumping system and removed bodily to the photographic dark room. Relative wave-length measurements of an accuracy of 0·1 % are obtainable. A. H.

See also **Abstracts 4441, 4504, 4549, 4707, 4736, 4757.**

HEAT.

CALORIMETRY.

4615. Effect of Dissolved Air on the Specific Heat of Water. R. Jessel. *Phys. Soc., Proc.* 46. *pp.* 747–763, *Nov.* 1, 1934.—The paper describes experiments performed by the continuous-flow electric method on the specific heat of distilled water both when de-aerated and when saturated with air. The difference between the two sets of results is described and an explanation is given. The findings of other observers are critically described in the light of these experimental results. AUTHOR.

See also Abstracts 4388, 4635, 4636, 4645, 4765.

CONDUCTION.

4616. Sources of Various Kinds near a Plane Boundary Separating Two Media. G. Green. *Phil. Mag.* 18. *pp.* 625–640, *Oct.*, 1934.—The wave-train method previously used by the same author is now applied to problems involving wave-motion near a plane boundary separating two media. The equations employed apply primarily to cases of heat-flow, but parallel results are obtained for problems in sound, elasticity, optics and wave-motion in general. The particular examples considered include those in which the source of heat is either a plane, a line or a point. In general, solutions are obtained for the case of a periodic source and the integrations required for instantaneous and continuous sources are indicated. The incident, reflected and refracted wave systems are dealt with in the case of the point source. R. W. P.

See also Abstract 4476.

CONVECTION.

4617. Heat Transfer from Steam Coil to Water. F. H. Rhodes. *Indust. & Engin. Chem.* 26. *pp.* 944–946, *Sept.*, 1934.—Results are given for the heat transfer from a steam-heated coil formed of ¾″ iron pipe to a bath of water for cases where the water is either mechanically stirred, or stirred by natural convection only. The rate of heat transfer per ft. of pipe is approximately 60 B.Th.U./hr./°F. difference in temperature between the water and steam when stirred, and varies with steam temperature from 36 to 40 B.Th.U. when unstirred. R. W. P.

4618. Thermal Leakage Rates of Dewar Flasks. W. P. White. *Rev. Sci. Instruments.* 5. *p.* 379, *Oct.*, 1934.—It has been found by K. S. and R. H. Cole that the thermal leakage to or from a Dewar flask is practically independent of the amount of liquid it contains [see Abstract 647 (1933)]. The present author describes an experimental test in which he finds the heat transfer from a full flask to be only about 75 % of that obtained when the flask is half-full. R. W. P.

DILATATION.

4619. Optical Lever and Furnace for Thermal Expansion of Small Specimens. H. G. Jones. *Journ. Sci. Instruments,* 11. *pp.* 325–328, *Oct.*, 1934.—A furnace, which has been found free from convection currents, is described, together with the calibration of a tripod used as an optical level. The system measures the expansion of specimens 0·15 cm. long and measures down to $8 \cdot 2 \times 10^{-6}$ cm. It can also be used for rolled specimens 0·03 cm. thick. AUTHOR.

MELTING AND BOILING POINTS.

4620. Melting Point Apparatus for Minute Samples. S. Granick. *Science*, 80. *pp.* 272–273, *Sept.* 21, 1934.—An instrument which can be fitted to an ordinary microscope is described for the observations of the melting points of samples available in quantitites of the order of 10^{-6} gm. It is suitable for temperatures up to 300° C. and the melting point is obtained from the reading of a thermometer which is calibrated against samples of known melting point. R. W. P.

4621. Ice Formation on Streams and the Production of Artificial Ice. G. Tammann and K. L. Dreyer. *Naturwiss.* 22. *pp.* 613–614, *Sept.* 14, 1934.—This paper deals with the formation and structure of ice on natural waters such as streams, lakes, etc. Artificial ice is found to differ in structure from the natural varieties and the various crystalline forms are described. The behaviour of 5 % NaCl solutions on freezing is discussed. The structure of artificial ice is found to be greatly similar to that of cast metals. H. H. Ho.

4622. Measurement of Rate of Evaporation. J. S. Owens. *Nature*, 134. *p.* 330, *Sept.* 1, 1934.—An apparatus is described for the direct measurement of the rate of evaporation of water, either from a free water surface or from a sample of soil. The surface under test is contained in a shallow pan which is so connected to a narrow graduated glass tube that the change in volume of water in the tube is equal to the total evaporation from the surface. R. W. P.

4623. Theoretical Comparison of Petroleum Distillation Systems. P. Meyer. *Inst. Petroleum Technologists, J.* 20. *pp.* 901–911, 1934.—In discussing the above [see Abstract 251 (1934)] **P. J. Roelfsema** stated that beyond a certain point, application of the two-component equations and the two-component calculation method of McCabe and Thiele to fractional distillation of the *n*-component mixture by continuous and batch methods appears incorrect. In general the use of a standardised numerical expression to denote degree of fractionation seems of doubtful value. **F. C. Cutting** discussed three sources of inherent error in comparing continuous and batch distillation processes by applying the McCabe and Thiele graph to the results obtainable from a given fractionating column. The author replied to the various points. T. H. P.

See also Abstracts 4388, 4417, 4480, 4635, 4636.

TEMPERATURE, MEASUREMENT OF.

4624. Temperature Measurement with Photo-Cells. J. Zetzmann. *A.T.M.* 4. *T*116–117, *Sept.*, 1934.—The instruments in use for measuring high temperatures usually suffer from inertia or require a definite time for adjustment and generally are only able to follow slow variations in temperature. In a pyrometer comprising a photo-cell, the inertia is very small and rapid fluctuations in temperature may readily be followed. The principles underlying the use of photo-cells for pyrometric work are outlined and the construction and calibration of a photo-cell pyrometer are described in detail. The use of various types of cell is discussed and the sensitivity and sources of error are pointed out. Recent literature on the subject is given. H. J. H. S.

4625. Photoelectric Temperature Control. B. Lange and E. Voos. *Zeits. f. techn. Physik*, 15. 8. *pp.* 323–326, 1934.—A circuit is described, comprising a photoelectric cell, thyratron, mirror galvanometer of short period and a selenium cell, for maintaining an electric furnace at a temperature of 1000° C. It is claimed that this temperature may be maintained to within 0·17° owing to the high speed of control. The control itself may be used to measure the temperature of the furnace. H. J. H. S.

See also Abstracts 4510, 4532, 4764.

THERMOCHEMISTRY.

4626. Thermochemistry of Non-Aqueous Solutions. F. A. Askew, N. S. Jackson, O. Gatty, J. H. Wolfenden, E. Bullock, A. E. C. and H. T. Smith and R. K. Tinkler. *Chem. Soc. J. pp.* 1362–1379, *Sept.*, 1934.—Description and tests of calorimeter. The heats of dilution of 17 univalent salts at high dilution in a number of solvents have been observed. These results are inconsistent with the Born-Bjerrum equation for the heat of solvation of ions. The heats of dilution of a number of salts have been measured for several organic solvents. Negative heats of dilution are rare. A correlation is found between negative heats of dilution and negative heats of dissociation and low heats of ionic solvation. The results are discussed. A. S. C. L.

4627. Significance of Chemical Bond Energies. C. T. Zahn. *J. Chem. Phys.* 2. *pp.* 671–680, *Oct.*, 1934.—In view of recently reported departures from bond additivity of chemical energies of formation, a purely empirical study has been made of the significance of chemical bond energies. If the energy of formation is assumed to consist of bond energies and interaction energies between the bonds, it is shown that both of these two types of energy are indeterminate so far as thermochemical data are concerned. It is also shown how energy of formation can be expressed in terms of apparent bond energies with a correction term involving the numerical departures from the additivity conditions. It is found that under a transformation of reference state to excited states of the atoms: (1) the additivity characteristics are invariant, and (2) the bond resonance energies as defined by Pauling are invariant, and therefore the reference of bond energies to excited states has no significance so far as these resonance energies are concerned. A discussion of atomic and bond additivity is given for physical quantities in general. It is pointed out that the energy connected with the nuclear motions, i.e., the heat content plus the zero-point energies of the vibrations, may be of the order of one-tenth of the total energy of formation,and it is proposed that "electronic energies" be introduced for the study of structural regularities in the energies of formation. A study is then made of available data in terms of the proposed scheme, and it is found that departures from additivity may be considerably greater than ordinarily supposed. It is further pointed out that Pauling's bond resonance energies could not accurately be considered as pure bond quantities if the interactions were appreciable, and that this may be the reason in part, that his electro-negativity map cannot, on the whole, be used successfully to predict the electric moments of chemical bonds. H. H. Ho.

4628. Ignition Temperatures of Gases. Concentric Tube Experiments of (the late) H. B. Dixon. H. F. Coward. *Chem. Soc., J. pp.* 1382–1406, *Sept.*, 1934.—During the last eight years of his life, the late H. B. Dixon's research was almost entirely concerned with determinations of the ignition temperatures of gases and vapours by two methods: (*a*) ignition by the heat of rapid compression, (*b*) ignition in the "concentric tube" apparatus. A summary of his work is now presented. In addition, an account is given of further work in a direction which Dixon's experiments had clearly indicated, and certain relations between some of his results and current theories of the ignition process are shown. The chief features are: (1) a record of ignition temperatures, especially the "rapid-ignition points" of 0·5 sec. lag, of a number of gases and vapours in air and in O_2, over a wide range of pressure; (2) the discovery that the presence of small amounts of NO_2 in the atmosphere (air or oxygen) reduces the ignition points of gases generally; this has led to important results in connection with the theory of chain reactions; (3) the discovery that the presence of small amounts of I_2 in the atmosphere raises the ignition points of H_2, CO, and CH_4, and that various compounds of Br raise the ignition point of CH_4; (4) a discussion of the results in terms of current theories. H. H. Ho.

4629. "Afterburning" in Gas Explosions. B. Lewis and G. v. Elbe. *J. Chem. Phys.* 2. *pp.* 659–664, *Oct.*, 1934.—The works of David, Brown and El Din, Ellis and Morgan, and Ellis and Wheeler on "afterburning" have been reviewed critically and found to contain no conclusive evidence for "afterburning." Experiments have been performed on explosions of hydrogen-oxygen mixtures with different inert gas in spherical vessels of different sizes which show, on the contrary, the absence of this phenomenon. The explosion method for determing heat capacities of gases may not be criticised on this account.

AUTHORS.

4630. Maximum Pressure Developed in Explosions in a Closed Vessel. B. Lewis and G. v. Elbe. *J. Chem. Phys.* 2. *pp.* 665–668, *Oct.*, 1934.—When a combustible gas mixture is exploded at the centre of a spherical vessel, a temperature gradient is established at the moment of maximum pressure which rises from the wall to the centre. The maximum pressure recorded is lower than would have been found had the temperature been equalised without heat loss. A method for calculating this difference in pressure is described. For ozone explosions it is shown to be less than 0·2 per cent in weak mixtures and less than 0·5 per cent in rich mixtures. For explosions of H_2 and O_2 with inert gases it amounts to 0·2 to 0·8 per cent. AUTHORS.

4631. Frequency of Detonation Spin. K. Shtsholkin. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 175–181, 1934. *In English.*—A formula for the frequency of detonation spin has been deduced. The frequencies calculated for various gas mixtures are compared with the known experimental values. AUTHOR.

4632. Explosive Antimony. Part I. Microscopy of Polished Surfaces. C. C. Coffin and S. Johnston. *Roy. Soc., Proc.* 146*A*. *pp.* 564–570, *Oct.* 1, 1934.—Electrolysis of antimony chloride solutions yields a soft, lustrous antimony. When this is heated or scratched, it undergoes sudden change, much heat being developed, the metal being shattered, and white fumes of occluded $SbCl_3$ evolved. The explosive metal is amorphous, and the explosion is simply a rapid exothermic crystallisation. After the explosion the polished surface is covered by well-defined, equally spaced parallel lines (2000–4000 per cm.), apparently straight at a distance from the point where the explosion started, but concentrically circular about this point. The lines are due to a regular crystallisation brought about by the spherical and autogenous heat wave travelling through the mass of metal. By measuring the distances from the line of meeting of two sets of waves—one of which is made a known fraction of a second after the other—to each of the two craters, the velocity at which the crystallisation wave travels through the metal is found to be about 23 cm. per sec. at room-temperature. T. H. P.

See also Abstracts 4384, 4518, 4598.

THERMODYNAMICS.

4633. Equation of State of Gases. Part II. K. Jablczynski. *Phys. Zeits.* 35. *pp.* 731–737, *Sept.* 15, 1934.—In continuation of previous work [see Abstract 4434 (1932)] the author shows that the equation of states of gases can be expressed, in agreement with numerous experimental data, in the form $\{p + (a_1/w^2) - A + B(w - b)T/w^2\}\{w - b\} = RT$, w denoting volume, a, A and B constants. J. S. G. T.

4634. Van der Waals' Equation for Gas Mixtures. E. Neusser. *Phys. Zeits.* 35. *pp.* 738–739, *Sept.* 15, 1934.—The co-volume b, in van der Waals' equation, applied to a gas mixture, is found to be additive in character, the value for the mixture being given by $b = b_1x + b^2(1 - x)$. A similar additive character is not shown by the cohesion pressure coefficient, α. J. S. G. T.

4635. Phase Diagram of Methane-Ethylene Mixtures. M. Ruhemann and A. Lichter. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 139–149, 1934. *In German.*—A vacuum calorimeter is used to obtain cooling curves and specific heats of methane-ethylene mixture and to determine the equilibrium curves. The eutectic point is found at 84·55° Abs. when the mixture contains 12·2 % of ethylene. The limit of solution of ethylene in methane is 2·5 ± 0·3 %. The excess specific heats of the mixtures are calculated from a formula based on the liquidus curve and the heat of fusion of one of the components, and found to be comparable with results of measurement. [See following Abstract.] H. M. B.

4636. Anomalous Specific Heats. B. and M. Ruhemann. *Phys. Zeits. d. Sowjetunion*, 6. 1–2. *pp.* 186–188, 1934. *In English.*—The computed curves of the specific heats of mixtures of various strengths, determined by cooling curves of methane-ethylene mixtures [see preceding Abstract] show a striking resemblance to anomalies observed in the specific heats of supposedly pure substances. At certain values, they resemble the effect accompanying transition to supraconductivity, at others, the specific heat of ferromagnetic substances near the Curie point, and also the characteristics of the so-called λ-phenomena. It is suggested that all these phenomena may be interpreted in terms of phase changes in binary systems. H. M. B.

4637. Heat Capacity Curves of the Simpler Gases. Part VI. H. L. Johnston and E. A. Long. *J. Chem. Phys.* 2. *p.* 710, *Oct.*, 1934. A correction. [See Abstract 3356 (1934).]

See also Abstracts 4403, 4591, 4598.

VAPOUR PRESSURE.

See Abstracts 4449, 4450.

ACOUSTICS.

4638. Precision Study of Piano Touch and Tone. H. C. Hart, M. W. Fuller and W. S. Lusby. *Acoustical Soc. of America, J.* 6. *pp.* 80–94, *Oct.*, 1934.—The loudness and tone quality of a piano note are determined by the motion of the hammer at the time of its impact with the string—theoretically, by its velocity, acceleration and higher time derivatives. Practically, due to the great rigidity of the hammer shank, the influence of the acceleration and higher derivatives is negligible. This study presents exact quantitative confirmation of the findings of other investigators that the loudness and tone of a piano note are uniquely determined by the velocity of the hammer at the time of impact with the string. AUTHORS.

4639. Valve-Maintained Stretched-Wire Vibrator. W. S. Stuart. *Phil. Mag.* 18. *pp.* 566–571, *Oct.*, 1934.—An arrangement for producing sustained vibrations of a stretched wire by means of thermionic valves is given. The complete apparatus serves as a very convenient generator of audio-frequency currents for laboratory purposes. AUTHOR.

4640. Generation and Application of Intense Supersonic Waves. H. Oyama. *Radio Research Japan, Report,* 4. *pp.* 41–55, *April,* 1934. *In English.*—A quartz plate 3·5 cm. dia. × 6 mm. formed part of an oscillation generator and was attached to a brass disc which acted as a reflector of the waves, mostly of frequency 450 kc./sec. When in action, the vibrator had an effective resistance round about 1000 ohms, and sound pressures up to 3 gm./cm.^{2} were measured. Wave propagation in oil was photographed by Foucault's method. The wave speed seemed to decrease with increase of frequency. With a frequency of 42550 kc./sec., Debye-Shears' diffraction spectra were observed to the 30th order. Oxidation of distilled water and several chemical and biological effects of the waves were observed. G. E. A.

4641. Ultrasonic Waves. Part IV. P. Biquard. *Rev. d'Acoustique,* 3. *pp.* 104–132, *May-July,* 1934.—This article, the fourth and last of a series entirely mathematical in character, treats of energy considerations in the piezoelectric generation of ultrasonic waves and examines the functioning of such emitters. [For Part III see Abstract 741 (1934).] E. J. I.

4642. Acoustic Radiation Field of Piezoelectric Oscillator. L. V. King. *Canad. J. of Research,* 11. *pp.* 135–155, *Aug.*, 1934.—The radiation field due to a circular disc oscillating with uniform amplitude in a closely fitting circular aperture surrounded by an infinite rigid flange has been studied in detail, the velocity potential being expressed as an infinite integral involving cylindrical coordinates. The procedure adopted may be used to study the effect of viscosity on the characteristics of the radiation field. While having little effect on the field in the neighbourhood of an oscillator generating waves in water, the viscosity has a marked effect on the range of distant transmission, which, in consequence, is appreciably affected by temperature. Of considerable practical importance is the existence of an optimum wave-length for constant output and a given distance of transmission. By means of a simple chart, it is possible to determine the optimum wave-length for a given transmitter when the level of reception for a given range is stated. AUTHOR.

4643. Ultrasonic Waves in Quartz. E. Hiedemann, H. R. Asbach and K. H. Hoesch. *Zeits. f. Physik,* 90. 5–6. *pp.* 322–326, *Aug.* 21, 1934.—Following the discovery by Lucas and Biquard [see Abstract 4458 (1932)] that light passing through an oscillating quartz crystal is diffracted as if the nodal system formed a diffraction grating, the authors have applied the method described in a previous paper on stationary ultrasonic waves in liquids [see Abstract 2581 (1934)] to the study of the nodal formation in an oscillating quartz crystal. It is shown that the total number of diffraction bands so obtained is equal to the number of the harmonic used. J. E. R. C.

4644. Acoustic Resonator Interferometer. J. C. Hubbard. *Phys. Rev.* 46. *p.* 525, *Sept.* 15, 1934.—A correction. [See Abstract 5122 (1932).]

4645. Pressure Coefficients of Acoustic Velocity for Nine Organic Liquids. J. C. Swanson. *J. Chem. Phys.* 2. *pp.* 689–693, *Oct.*, 1934.—With a pressure supersonic interferometer especially devised for this purpose, nine organic liquids are examined at frequencies a little less than 200 kc. and at temperatures varying from 22·7° C. to 25·5° C. for the various liquids. The acoustic velocity is measured at intervals from atmospheric pressure to a pressure of 300 kg./cm.^{2}. The values of the acoustic velocity (m./sec.) in the liquids at the pressures indicated are given below :

Liquid	C_2H_5Br	CCl_4	$CHCl_3$	$C_2H_5OC_2H_5$	C_5H_{12}	CS_2	C_6H_6	C_7H_8	$C_6H_5NH_2$
Atmospheric Pressure	885	912	986	993	1005	1136	1290	1313	1640
300 kg./cm.^{2} *Pressure*	1000	1048	1097	1255	1281	1268	1416	1447	1745

This method is being used for the determination of the value of the specific heats at other than atmospheric pressure. AUTHOR.

4646. Reverberation in Presence of Apertures. D. Faggiani. *Accad. Lincei, Atti,* 19. *pp.* 887–891, *June* 17, 1934.—It is noted that the formula of Millington and Sette [see Abstracts 5129 (1932) and 1979 (1933)] for the time of reverberation leads to an absurdity when in the places examined there are zones with unitary absorption. If the influence of the apertures in the general case is calculated an expression is reached which, applied to the treatment of Millington and Sette, does not present that absurdity. The general formula here found, which is applicable also to other treatments, is valid on the hypothesis of uniformly distributed sonorous energy. In the author's treatment the apertures are considered separately from the remaining lateral surface, and being apertures and not having reflecting power behave physically in a way different from the other zones, and thus the treatment corresponds better with the facts. J. J. S.

4647. Methods for the Study of Reversible Microphones in Air and in Water. R. Dubois. *Rev. d'Acoustique,* 2. *pp.* 253–287, *July,* 1933, *and* 3. *pp.* 27–46, *Jan.–March,* 1934.—The author aims at familiarising his readers with the method of Kennelly by applying it to electro-acoustic apparatus capable of transforming acoustic into electric energy and *vice versa.* An equation is formulated for the e.m.f. developed in a microphone by a periodic vibration and methods for determining its value in terms of the diaphragm velocity are described. There follows a study of the mechanical properties of a reversible microphone in terms of impedances; it is illustrated by Kennelly diagrams upon which the subsequent discussion is based. A bridge for measuring inductance and a.c. resistance is described with the object of facilitating the use of the method, whose application to the study of an electromagnetic oscillograph is also indicated. Some aspects of forced vibration are considered in two Appendices. E. J. I.

4648. Testing of Sound Receivers. M. Kluge. *A.T.M.* 4. T120, *Sept.*, 1934.—For absolute measurements with electro-acoustic sound receivers their sensitiveness in dependence on frequency and direction of sound must be known. A microphone can be tested in two ways: (1) if on its membrane a known sound pressure acts, and (2) if the microphone is brought into a sound field whose sound pressure before bringing in the microphone is known. These two methods are considered and also the relation between them. J. J. S.

4649. Voice Analysis. M. Marro. *Electrician*, 113. *pp.* 272–273, *Aug.* 31, 1934.—A rapid method of analysing voice oscillograms is described. The oscillogram is suitably enlarged and a sheet of opaque paper cut so that its contour coincides with the oscillogram. The paper is wrapped round a transparent cylinder which may be rotated at a wide range of speeds. A lamp is fixed inside the cylinder and the transmitted light falls upon a photocell. The photocell output is amplified and fed to an electromagnet which acts upon a tuning fork, the amplitude of which can be measured. The analysis is obtained by driving the cylinder at a series of harmonically related speeds and in each case determining the amplitude of the tuning fork. These amplitudes are taken as measures of the Fourier components of the analysis. J. E. R. C.

4650. Aural Rectification. E. Z. Stowell and A. F. Deming. *Acoustical Soc. of America, J.* 6. *pp.* 70–79, *Oct.*, 1934.—Rectification in the ear is of some importance in the study of propeller noise. Data on this phenomenon have been obtained by using modulated signals. Twenty out of twenty-one observers were able to hear the modulating frequency as a result of rectification. Quantitative estimates of the magnitude of this subjective tone have been obtained. Measurements have been made of the increase in loudness level due to rectification. Results indicate that rectification may be a property of the basilar membrane rather than of the ear drum or the ossicles of the middle ear, as previously supposed. AUTHORS.

4651. Noise Level Due to Addition of Two Sound Sources. F. Aigner and M. J. O. Strutt. *Zeits. f. techn. Physik*, 15. 9. *pp.* 355–360, 1934.—When the path difference between two sound sources is less than a certain value they cease to be distinguishable. The authors have, therefore, made experiments to determine whether the noise level due to two indistinguishable sources can be calculated by adding their energies. Two loud-speakers are used in a moderately reverberant room each delivering sound of the same loudness, and the resulting noise level is measured with a Barkhausen audiometer. The phase difference between the sounds reaching the observers is achieved (*a*) by spacing the loud-speakers and (*b*) by feeding the loud-speaker amplifiers from two spaced pick-ups working on the same gramophone record. By using suitable circuits the loud-speakers' outputs could have differing qualities. The following are the results: (1) The noise level is calculable from the sum of the energies if the sounds reaching the observer have no path difference and/or if they have identical qualities. (2) The noise level is greater than that calculated from the energy sum if the sounds are of dissimilar quality and have no appreciable path difference. (3) The discrepancy increases continuously as the path difference and/or the quality difference is increased there being no limit below which the phenomenon cannot be observed. J. E. R. C.

4652. Range of Sound Intensities in Music. S. Kagan. *Rev. d'Acoustique*, 3. *pp.* 3–26, *Jan.–March*, 1934.—A detailed account and consideration of work carried out by the author under the direction of K. W. Wagner who has already communicated the results elsewhere. [See Abstract 2515 (1933).] E. J. I.

4653. Absorption of Sound in Gases. Y. Rocard. *Rev. d'Acoustique*, 3. *pp.* 47–62, *Jan.–March*, 1934.—A mathematical paper in which the magnitudes and frequency variations of the effects of thermal conduction, viscosity, diffusion in gas mixtures [see Abstract 1610 (1931)], and the transfer of molecular vibrational energy [see Abstracts 5390 and 5391 (1933)] on the absorption of sound in a gas are considered and compared. E. J. I.

4654. Intensity Distribution of Sound from a Tuning-Fork. G. Araki. *Phil. Mag.* 18. *pp.* 441–449, *Sept.*, 1934.—The author treats the following cases mathematically: (1) the wave from an infinite line source moving with constant velocity perpendicular to its length; (2) the wave from a plane source of infinite length vibrating at right angles to the plane, and (3) two plane sources vibrating at right angles to each other with a phase difference π. Applying to the fork the results of these articles, the author finds the loci of points of minimum intensity to be two straight lines at 45° to the prongs. G. E. A.

4655. Equal-Tempered Musical Scale. C. F. Hagenow. *Am. Phys. Teacher*, 2. *pp.* 81–84, *Sept.*, 1934.—In many elementary physics texts it is stated that the chief reason for the employment of the tempered scale in music is the prohibitive complexity of keyed instruments so constructed as to provide all the tones of a true scale in every key. It is not emphasised sufficiently that the performance of modern music would be quite impossible even if players could be found to manipulate such instruments. The author emphasises the fact that aesthetic considerations necessitate a certain compromise between the demands of the composer and the restrictions imposed by " true " intonation. A number of peculiar inconsistencies inherent in the true scale itself are pointed out, and mention is made of the paradoxical fact that the perfectly tuned strings of a violin are, in many instances, not in tune with the tones of the true scale. AUTHOR.

4656. Doppler Effect for Sound in a Moving Medium. R. W. Young. *Acoustical Soc. of America, J.* 6. *pp.* 112–114, *Oct.*, 1934.—An alternate derivation of the Bateman formula for Doppler's principle [see Abstract 3158 (1931)] is described. A method is given for the evaluation of the direction cosines which appear in this formula, so that in the special case of constant velocities of sound, and of the medium

$$\frac{\nu'}{\nu}=\frac{u[a^2-(v^2+w^2)]^{\frac{1}{2}}+a^2-v^2-w^2-[a^2-(v^2+w^2)]^{\frac{1}{2}}U_1+vV_1+wW_1}{u[a^2-(v^2+w^2)]^{\frac{1}{2}}+a^2-v^2-w^2-[a^2-(v^2+w^2)]^{\frac{1}{2}}U_0+vV_0+wW_0}$$

where u, v, w are component velocities of the medium, a is the velocity of sound, U_0, V_0, W_0 the component velocities of the source, and U_1, V_1, W_1 those of the observer. The x-axis here connects source and observer, and ν and ν' are, respectively, the original and observed frequencies. The case of a stratified medium is also considered. AUTHOR.

See also Abstract 4616.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

4657. Dielectric Power-Factor Measurements at Audio and Radio Frequencies. G. M. L. Sommerman. *Rev. Sci. Instruments,* 5. *pp.* 341–345, *Oct.,* 1934.—The paper presents a description of sensitive and accurate apparatus for measuring the power factor of dielectrics in the frequency range, 60–7,200,000 c.p.s. A Wien bridge with Wagner earth for the direct measurement of both power factor and frequency in the range, 60–10,000 c.p.s. is described. Double shielding of the series resistance arm eliminates errors otherwise inherent in this bridge. The operation of the resonance-substitution method is discussed for the frequency range, 10,000–7,200,000 c.p.s. Errors due to eddy current losses are eliminated through measurements on loss free liquids. A measuring cell for use with these circuits and also with d.c. measuring circuits is described. Some experimental power factor-frequency curves illustrating the results obtainable with this apparatus are presented. It is shown that power factor-frequency data furnish a delicate method of tracing out dispersion phenomena and are useful where the concentration or electric moment of material producing dispersion is small. AUTHOR.

CONDUCTION AND DISCHARGE IN GASES.

4658. Growth of Electron Concentration and Calculation of Current Strength in Gas Discharge. N. Kapzov. *Phys. Zeits. d. Sowjetunion,* 6. 1–2. *pp.* 82–120, 1934. *In German.*—The theory of gas discharge proposed by Townsend is based on certain simplifying assumptions and suffers from several defects. These are briefly outlined and discussed. A new method, which overcomes certain of the defects of the former theory, is suggested for calculating the behaviour of electrons in gases at low pressure. The ionisation probability and the loss in velocity by elastic and inelastic collisions is considered. Special solutions of the general problem are worked out for certain simple cases and the limits of validity are ascertained. A new significance is found for the factor of Townsend. The theory of G. Hertz on the increase in velocity of an electron in an electric field in a gas is completed by considering the loss in velocity by inelastic collisions. H. J. H. S.

4659. Control of Electric Currents in Air at Atmospheric Pressure. W. Hucke. *Arch. f. Elektrot.* 28. *pp.* 593–596, *Sept.* 15, 1934.—Experiments with ordinary Bunsen flames are first described. Various electrode systems were employed. In some of these both electrodes were situated in the flame, while in others one was in the flame and the other outside it at a distance from the first electrode of about 15 mm. In other experiments a control grid was mounted between the two electrodes near to the outer one. Details are given of the current-potential characteristics of the different arrangements. Experiments were also carried out with a Nernst pencil as the glowing kathode of an electrode system similar to that used in triodes and also with the grid omitted. Current-potential characteristics are given for different heating currents and various anode and grid voltages, the anode voltages ranging up to 1500 V. A. W.

4660. Kathode Fall of Potential. E. W. Pike. *Zeits. f. Physik,* 90. 5–6. *pp.* 319–321, *Aug.* 21, 1934.—The results of the author's experiments on the kathode fall of potential in the discharge through rare gases are briefly reported. Although precautions as to purity of gases and electrode metal were taken, reproducible values of the kathode fall could not be obtained. Approximate values for various gases are given, using different kathode materials. J. E. R. C.

4661. Dynamics of Non-Stationary Gas Discharges. Part I. H. Gawehn. *Ann. d. Physik,* 20. 6. *pp.* 601–634, *Sept.*, 1934.—The question whether the momentary values of current and voltage determine uniquely the dynamic state of a gas discharge must be answered in the negative. In spite of this it is very useful to consider the I-V plane as, to a first approximation, a unique state plane. The theoretical deductions based on this are found to agree closely with experimental results. Oscillograph records of the dynamic characteristics of intermittent glow discharges obtained by two different methods, exhibit the features which are to be expected on theoretical grounds. A. W.

4662. Ionisation Potentials of Formaldehyde and Halogen Derivatives of Methane. T. N. Jewitt. *Phys. Rev.* 46. *pp.* 616–617, *Oct.* 1, 1934.—The ionisation potentials of CH_2O, CH_3Cl, CH_3Br, CH_3I were measured by a molecular ray method, and found to be 11·3, 10·7, 10·0 and 9·1 volts, respectively. AUTHOR.

4663. Capture of Electrons by Positive Ions from Neutral Gas Atoms. R. A. Smith. *Cambridge Phil. Soc., Proc.* 30. *pp.* 514–519, *Oct.* 30, 1934.—An apparatus for the production of beams of fast positive ions is described. Measurements of the cross-section for capture of an electron by a positive ion from a netural gas atom are given in the case of He^+ ions in He and protons in He and H. These are compared with the theory given by Massey and Smith [see Abstract 5009 (1933)], and as far as possible with previous experiments. AUTHOR.

4664. Ionisation by Positive Ions in Helium. J. S. Townsend and G. D. Yarnold. *Phil. Mag.* 18. *pp.* 594–606, *Oct.*, 1934.—Results in hydrogen [see Abstract 1998 (1933)] and in helium show that molecules of these gases are ionised by single collisions of electrons and positive ions. The coefficients, α, β and γ denoting respectively the coefficient of ionisation by electrons, by positive ions, and the ratio of the number of electrons liberated from the negative electrode to the number of positive ions that impinge on it, it is found that α, β and γ depend only on the electric force and the pressure of the gas and are the same for small photoelectric currents as for currents of the order 10^{-5} ampere between parallel plates or for currents of order 10^{-3} ampere in the positive column of discharge tubes. Changes in the coefficients observed with larger currents are attributed to various disturbances. The results indicate that the particles ionised are normal gas atoms. The results are all in agreement with theory, and show that the general hypotheses on which the original theory was based apply to He as well as to diatomic gases. J. S. G. T.

4665. Geiger-Müller Counter with Polished Electrodes. E. Henning and R. Schade. *Zeits. f. Physik,* 90. 9–10. *pp.* 597–606, *Sept.* 6, 1934.—The operation of efficient tube counters with polished electrodes is described. Tubes of different sizes and materials are used, the most common being an iron tube 5 cm. long and 1·3 cm. wide, carrying a central tungsten wire. The tube exhibits approximately constant sensitivity for a breadth of about 700 volts. The dependence of the breadth of the counting range on the leak resistance, gas pressure and tube diameter was investigated. F. C. C.

4666. Mutual Effects of Electron Beams. G. Wendt. *Arch. f. Elektrot.* 28. *pp.* 529–534, *Sept.* 15, 1934.—Calculations are made of the mutual repulsion of two parallel electron beams in a high vacuum, and an experimental investigation of the mutual effects of two gas-concentrated electron beams is described. The calculations show that in high vacuum kathode-ray tubes with several rays whose dimensions and current strengths correspond to those for the usual type of single-ray tube, no appreciable influence of the rays on one another should be observable for potentials up to 100V. The experiments with two gas-concentrated electron beams showed that for low ray voltages (500 to 800 V.) no influence of the rays on one another could be observed. Hence, so far as mutual effects of the individual beams are concerned, multi-ray kathode-ray tubes can be built either with or without gas-filling. A. W.

4667. Electric Lenses for Cold-Kathode Kathode-Ray Oscillograph. F. Malsch and F. A. Becker. *Arch. f. Elektrot.* 28. *pp.* 580–586, *Sept.* 15, 1934.—For oscillographs of the sealed glass type electrostatic lenses have certain advantages as compared with magnetic lenses. In oscillographs of the cold-kathode type difficulties are experienced with the ordinary type of electric lens due to discharges between the lens electrodes consequent on the high voltage necessary. Forms of lenses are given for which such discharges do not occur even at relatively high voltages. A new form of lens due to Rogowski is described in which the counter-electrode of the lens can be maintained at the potential of the kathode, so that only one high potential source is required for the discharge tube and the lens. Details are also given of an oscillograph in which the pre-concentration and main lenses are both of the electrostatic type, the time and oscillation deflections both being effected by means of coils. A typical oscillogram obtained with this apparatus is reproduced. A. W.

4668. Achromatic Electron Lenses. W. Henneberg. *Zeits. f. Physik*, 90. 11–12. *pp.* 742–747, *Sept.* 17, 1934.—It is shown theoretically that it is impossible to obtain a chromatically corrected short electrical single or immersion lens. On the other hand it is, in principle, possible to construct an achromatic lens with two apertured diaphragms. The potential gradient through such a lens is given but there is little practical application for this type of lens. J. E. K.

4669. Electrical Immersion Objective as Focusing System in a Braun Tube. H. Johannson. *Zeits. f. Physik*, 90. 11–12. *pp.* 748–753, *Sept.* 17, 1934.—The suitability of the electrical immersion objective (electron microscope) for adaptation to the focusing of the beam in a Braun tube is discussed and a formula for the magnification of the system is derived. Reference is made throughout to the results of a previous theoretical investigation of the immersion objective [see Abstract 297 (1934)]. J. E. K.

4670. Demonstration of a L.V. Electron Microscope Using Electrostatic Focusing. W. E. Benham. *I.E.E., J.* 75. *pp.* 388–390, *Sept.*, 1934.—A short account is given of an electron microscope in which the electrode system is similar to that devised by Zworykin. The action of the lens is considered theoretically and the focal lengths of the electron optical system are deduced with the aid of a formula given by Davisson and Calbick. The values so derived are not confirmed experimentally and suggestions are made to account for the discrepancies. The resolving power and applications of the electron microscope are briefly considered. H. J. H. S.

4671. Dependence of Residual Ionisation Current on Pressure and the Connection with Measurements of Penetrating Radiation. P. Pfundt. *Zeits. f. Physik*, 90. 7–8. *pp.* 440–456, *Sept.* 4, 1934.—The dependence of the residual ionisation current on the gas pressure in high pressure ionisation chambers containing CO_2 is investigated. The correctness of the interpretation of the pressure curve obtained was confirmed by measurements on another ionisation chamber with artificially increased residual ionisation. The maximum effect due to α-rays occurs at about 0·25 atmosphere, while the β-rays are most effective at about 4·5 atmospheres. The necessary correction for the true penetrating radiation current is indicated for different ionisation chambers. For two chambers used in the Bodensee and filled with CO_2 at pressures of 29·4 and 1 atmosphere respectively, a correction involving a constant factor of **1/10·2** deduced from consideration of the residual currents brings the two sets of results into agreement. F. C. C.

4672. Effect of Space Charges on the Measurement of Ionisation Currents. A. Trost. *Phys. Zeits.* 35. *pp.* 725–730, *Sept.* 15, 1934. —It is shown that in ionisation-current measurements by either the charge or discharge method at high pressures and with large ionisation chambers and strong ionisation, the results obtained may be influenced considerably by space-charge effects. The errors in the results due to space-charge effects are shown to be proportional to the square of the chamber volume and to the ionisation strength, and inversely proportional to the square of the capacity and to the mobility of the ions. The formulæ obtained show that with the same ionisation chamber different results may be obtained according to the direction of the field and to the electrometer capacity. A. W.

4673. High-Pressure Expansion Chamber. L. M. Mott-Smith. *Rev. Sci. Instruments*, 5. *pp.* 346–350, *Oct.*, 1934.—An expansion chamber similar to that of Wilson [see Abstract 5016 (1933)], but which can be operated at about 15 atmospheres is devised. The appearance of the tracks is not markedly different from that at atmospheric pressure. F. C. C.

4674. Removal of Ions from Convection Currents. J. J. Hellemann. *Am. Phys. Teacher*, 2. *pp.* 116–117, *Sept.*, 1934.—A lecture-demonstration apparatus is described, the purpose of which is to show that ions are present in the convection current from a gas flame and that these ions can be removed by an electrically charged filter. The filter consists of a metallic funnel which directs the convection current through a wire gauze. A 45-volt battery is sufficient to charge the funnel and gauze. AUTHOR.

4675. Production of Heavy High-Speed Ions Without High Voltages. D. H. Sloan and W. M. Coates. *Phys. Rev.* 46. *pp.* 539–542, *Oct.* 1, 1934.—A description is given of improvements in the Sloan-Lawrence method of accelerating heavy ions [see Abstract 1718 (1932)]. The new apparatus yields mercury ions with energies of 2,850,000 electron volts, while the previous apparatus yielded ions with energies of 1,260,000 electron volts. The intensity of the beam of ions is of the order of 10^{-8} ampere—only slightly less than in the previous tube which was considerably shorter. The new tube withstands the application of 79,000 volts while the previous tube was limited to 42,000 volts. This improvement is due principally to decreased heating of the electrodes as a result of lowering their resistance and capacity. The spacing of the electrodes has been increased to 20 % of their length, and their diameter decreased from 13 mm. to 6 mm. The number has been increased from 30 to 36 and the length of each is now 25 % greater. The possibility of extending this method to the acceleration of lighter ions is discussed. AUTHORS.

See also Abstracts 4455, 4560, 4706, 4707, 4719, 4742, 4748, 4762.

CONDUCTION IN SOLIDS AND LIQUIDS.

4676. Electrostatic Voltmeter. M. Y. Warner. *Am. Phys. Teacher*, 2. *pp.* 75–76, *May*, 1934.—An electrostatic voltmeter was built on the principle of the Coulomb electrostatic balance. It is of the repulsion type and designed to indicate potentials of 10,000–80,000 volts to a large class in physics. AUTHOR.

4677. H.T. Measurement by Electron Diffraction. E. Rupp. *Ann. d. Physik*. 20. 6. *pp.* 594–600, *Sept.*, 1934.—A narrow beam of electrons, accelerated by the voltage to be measured, passes through thin gold foil on to a photographic film, which records the diffraction rings produced. The diameters of the rings are measured, and the wave-length of the electrons and the applied voltage are then calculated from de Broglie's equation, using the known value for the lattice constant of gold. Direct voltages between 70 and 280 kV can be measured with an accuracy of 0·6 to 0·8 %. The method was used for the calibration of a Starke-Schröder electrometer. L. H.

4678. Peak Voltmeter for Low Voltages. C. R. Stoner and G. L. Grisdale. *Journ. Sci. Instruments*, 11. *pp.* 313–315, *Oct.*, 1934.—The diode peak voltmeter may have its useful range extended downwards to 1–10 volts by a modified circuit. The instrument may be made direct reading and more accurate than some other types. AUTHORS.

4679. Measurement of Small Galvanometer Deviations. M. Czerny. *Zeits. f. Physik*, 90. 7–8. *pp.* 468–479, *Sept.* 4, 1934.—Instead of a millimetre scale an illuminated slit was used. A plane parallel plate was interposed between the galvanometer mirror and the slit. The deviations of the galvanometer caused a movement of the image of the slit in the telescope and this could be compensated by revolving the plate through a corresponding angle. The tangent of the angle through which the plate was turned gave a measurement of the extent of the deviation. W. R. A.

4680. Theory of Moving-Coil Galvanometers. A. V. Hill. *Journ. Sci. Instruments*, 11. *pp.* 309–313, *Oct.*, 1934.—In the construction of moving-coil galvanometers, the combined demand for quickness and sensitivity can be met only if due attention be paid to the theory of their design. The necessary equations are given in the paper, the importance in certain cases of air damping is pointed out and characteristics of twelve actual instruments are tabulated. AUTHOR.

4681. Nonmetallic Conducting Films. S. Bloomenthal. *Physics*, 5. *pp.* 225–232, *Sept.*, 1934.—Immutable conducting films, which adhere to any clean solid have been formed from synthetic resin solutions holding finely ground carbon in suspension. Values of surface resistivity for uniformly thin films were secured in the range 15 to 10^6 ohms referred to unit area of surface. When the thickness is held constant, the resistivity depends mainly upon the proportion of binder present and the kind of carbon used. The experimental error in repeating values of resistance with a given suspension is about ± 20 %. The dependence of resistance upon resin content of the film appears to be in accord with the views of Frenkel [see Abstract 1627 (1931)] concerning gap contacts and in definite disagreement with the classical Maxwell theory of composite conductors. The behaviour of various types of carbon, when used in the films, can be predicted qualitatively from electrical measurements made upon powdered samples subjected to high pressure. Absorption of moisture by a film leads to a rise in resistance. AUTHOR.

4682. Theory of Supraconductivity. H. Bethe. *Zeits. f. Physik,* **90.** 9–10. *pp.* 674–679, *Sept.* 6, 1934.—The author claims that Schachenmeier's wave-mechanics theory [see Abstract 3385 (1934)] is fundamentally unsound. **Schachenmeier** [ibid. *pp.* 680–692] maintains his original position. W. S. S.

4683. Temperature Coefficient of Conductance of Electrolytes. R. M. Fuoss. *Am. Chem. Soc., J.* **56.** *pp.* 1857–1859, *Sept.,* 1934.—A theoretical derivation of the temperature coefficient of the conductance of electrolytes in solvents of low dielectric constant is presented. This coefficient is shown to contain three terms: a viscosity term and two terms arising from the shift of the simple ionic equilibria with temperature. The dependence of the coefficient on temperature and concentration is discussed. An asymptotic expansion for the calculation of the triple ion constant, valid for solvents of dielectric constant under 10, is obtained. AUTHOR.

4684. Influence of Temperature on the Conductance of Electrolytes in Anisole. G. S. Bien, C. A. Kraus and R. M. Fuoss. *Am. Chem. Soc., J.* **56.** *pp.* 1860–1865, *Sept.,* 1934.—The conductance of tetra-*n*-butylammonium nitrate and picrate in anisole, over the concentration range 0·00001 to 0·01 *N* and the temperature range − 33 to + 95·1°, are presented. The experimental results at concentrations up to about 0·001 *N* are in numerical agreement with results calculated from previously derived equations which are based on the hypothesis of ion association. AUTHORS.

4685. Ionisation of Weak Electrolytes in Heavy Water. G. N. Lewis and P. W. Schutz. *Am. Chem. Soc., J.* **56.** *pp.* 1913–1915, *Sept.,* 1934.—Preliminary measurements were made of the conductivity at 25° of deutacetic acid, chlorodeutacetic acid and deutammonia in heavy water. From these measurements, and rough estimates of the conductivities at infinite dilution, ionisation constants which are notably smaller than those found for the corresponding hydro compounds in ordinary water have been found. The theoretical implications of these results are discussed. AUTHORS.

4686. Deviation from Ohm's Law of Poor Conductors in Strong Electric Fields. L. Landau and A. Kompanejez. *Phys. Zeits. d. Sowjetunion,* **6.** 1–2. *pp.* 163–169, 1934. *In German.*—In this mathematical paper the problem of the field dependence of the electron density is regarded as open, and the entire conduction process is considered from an electron number standpoint. The results are compared with the experimental data of Kikoin and Noskov for Cu_2O [see Abstract 3431 (1934)], and the requisite numerical interpretation is given to the theoretical expressions. H. H. Ho.

See also Abstracts 4369, 4690, 4766.

DIELECTRICS AND CAPACITANCE.

4687. Dielectric Constants of Cis-Trans-Isomers in Aqueous Solution. G. Devoto. *Zeits. f. Elektrochem.* 40. *p.* 641, *Sept.*, 1934.—A continuation of previous work [see Abstract 3881 (1934)]. C. B. A.

4688. Heating of Cylindrical Bodies in H.F. Condenser Fields. N. N. Malov. *Zeits. f. Physik,* 90. 11–12. *pp.* 802–809, *Sept.* 17, 1934.—A calculation is made of the electric field in cylindrical dielectrics. On the basis of this calculation some phenomena are explained which are observed with the heating of liquids, woven tissues and other objects in the h.f. condenser field. Further the conditions of the cooling of the investigated objects are discussed, and also the distortions of the field produced by the cooling. J. J. S.

4689. Variation of Dielectric Constant of Rochelle Salt Crystals with Frequency and Applied Field Strength. A. Zeleny and J. Valasek. *Phys. Rev.* 46. *pp.* 450–453, *Sept.* 15, 1934.—The dielectric constant of Rochelle salt crystals perpendicular to the *a* axis at 0° C. was measured over the frequency range of 30 to 30×10^6 cycles/sec. Following a fairly uniform decline from 62,000 at 30 cycles to 220 at 10^7 cycles, the dielectric constant drops abruptly to negative values (inductive reactance) at 14×10^7 cycles. This frequency is independent of the size and mounting of the crystal and thus appears to be critical for this crystalline material. AUTHORS.

4690. Capacity of Electrolytic Resistances. M. Jeżewski. *Phys. Zeits.* 35. *pp.* 748–749, *Sept.* 15, 1934.—In reply to a statement of Graffunder's [see Abstract 2612 (1934)] that resistances described by Jeżewski in a previous work on the dielectric constants of aqueous solutions were unsuitable for precision measurements [see Abstract 1615 (1933)] Jeżewski explains how his own resistances are applicable in the resonance circuit which he used and that Graffunder's experiments were not comparable with his as the resistances were used under entirely different conditions. R. L.

4691. Representation of Periodic Error in a Gear-Driven Precision Condenser. J. E. Binns and W. I. Kisner. *Rev. Sci. Instruments,* 5. *pp.* 377–378, *Oct.*, 1934.—A gear-driven condenser fitted with semi-circular plates was found to exhibit periodic deviations from linearity of scale, which recurred at every turn of the worm-gear, and which, apart from slight irregularities, could be represented by a sine function. T. I. J.

See also Abstracts 4498, 4657.

ELECTROCHEMISTRY.

4692. Electrolytic Preparation of Cerium and Lanthanum Silicides. M. Dodero. *Comptes Rendus,* 199. *pp.* 566–568, *Sept.* 10, 1934.—With a carbon crucible as anode and an iron rod as kathode a bath composed of $CaSiO_3 + 2CaF_2 + 1/3CaCl_2 + 1/10CeO_2$ when electrolysed at 1000° with 20–30 amperes at 8–10 V. for 0·75–2 hr. gave a product containing 87·3–91·4 % of practically pure $CeSi_2$, accompanied by small amounts of Si, $FeSi_2$, and Ca. In similar fashion, if La_2O_3 be substituted for CeO_2, 94·4–98·4 % of equally pure $LaSi_2$ was obtained as steel-grey grains. A stronger current and higher temperature gave a lower yield. C. A. S.

4693. Distribution of Ions in Electrolytic Solutions. R. M. Fuoss. *Faraday Soc., Trans.* 30. *pp.* 967–980, *Oct.*, 1934.—Ion pairs are defined as follows: A positive ion and a negative ion, the centre of which lies in dr at a distance r from the positive ion, are defined as an ion pair, provided that no other unpaired negative ion lies within a sphere of radius r drawn around the positive ion. The probability curve for such configurations has in general two peaks, one corresponding to short-range pairs and the other to pairs whose mutual distances approximate those between uniformly distributed uncharged solute particles. The latter group automatically satisfy the Debye-Hückel condition which makes possible the time average treatment of their interaction. The short-range pairs may be considered as single dipole particles, and the equilibrium between bound and free ions may be treated by the formal methods of dissociation theory. The region of the minimum between the peaks of the curve is interpreted as corresponding to ions instantaneously in the transition stage between short-range and long-range pairs. The approximate validity of a formula previously used to calculate apparent dissociation constants of ion pairs in terms of dielectric constant, temperature and ion size is confirmed. Certain improvements in this calculation are suggested. AUTHOR.

4694. Electrode Potential of Palladium Black in Buffer Solutions. P. Nylén. *Arkiv f. Kem. Min. och Geologi, Stockholm,* 11B. No. 32. [6 *pp.*], 1934. *In English.*—A series of measurements of the potential of palladium black in different buffer solutions were made. The potential was found to rise and reached a reproducible value which was maintained for some hours. After this the potential rose to a new value, which decreased and increased irregularly. It was shown that the pH of the solution affected the constant potential of the electrode. A Pd electrode could be renewed by charging with H_2 or by placing it in a strong reducing agent especially a hypophosphite. The H_2 in the deposit was not readily removed by O_2 or oxidising agents. F. J. B.

4695. Substitute for Platinum Anodes in Electrolytic Oxidation. Part II. Gösta Angel and H. Mellquist. *Zeits. f. Elektrochem,* 40. *pp.* 702–707, *Sept.,* 1934.—Electrodes were prepared by depositing lead peroxide from an alkaline solution of lead tartrate on to iron, steel, copper and on to electrodes which were gold plated. A hard coherent deposit of PbO_2, H_2O was obtained. It was shown that the formation of perchloride was possible with these electrodes, and that the yield of perchlorate increased as the anodic current density was increased. Under favourable conditions it reached 79·2 % with a current density of 20 A/dm.^{2} and a temperature of 15° C. Higher current densities damaged the electrode. [For Part I see Abstract 4332 (1934)]. F. J. B.

4696. Standard Potential of the Ferric-Ferrous Electrode at 25°. W. C. Bray and A. V. Hershey. *Am. Chem. Soc., J.* 56. *pp.* 1889–1893, *Sept.,* 1934.—By using a graphical application of the Debye-Hückel theory, already developed by Randall, the following constants were calculated at 25° from measurements available in the literature.

$Fe^{+++} + E^{-} = Fe^{++}$; $E^0 = 0{\cdot}772 \pm 0{\cdot}001$ volt; $Fe^{+++} + H_2O = FeOH^{++} + H^{+}$; $K_1^0 = (60 \pm 5) \times 10^{-4}$; $2Fe^{+++} + 2Hg = 2Fe^{++} + Hg_2^{++}$; $K_2^0 = 0{\cdot}137 \pm 0{\cdot}010$ $E_2^0 = -0{\cdot}026 \pm 0{\cdot}001$; $Fe^{+++} + Ag = Fe^{++} + Ag^{+}$; $K_3^0 = 0{\cdot}363 \pm 0{\cdot}015$ $E_3^0 = -0{\cdot}026 \pm 0{\cdot}001$; $Fe^{+++} + Cl^{-} = FeCl^{++}$; $K_7^0 = 20 \pm 5$; At 35° $K_1^0 = (120 \pm 15) \times 10^{-4}$ $K_2^0 = 0{\cdot}55 \pm 0{\cdot}05$.

The electrode potentials are 25 mV higher than the previously accepted values. The equilibrium quotient of reactions involving ferric ion, which decrease rapidly in low ionic strength, are nearly constant when $\mu^{\frac{1}{2}} = 0{\cdot}6$ to

1·0. Approximate values in this range are $K_1 = 18 \times 10^{-4}$, $K_1 = 0{\cdot}022$, $K_3 = 0{\cdot}11$, $K_7 = 3$, at 25°. AUTHORS.

4697. Anodic Passivation of Gold. W. J. Shutt and A. Walton. *Faraday Soc. Trans.* 30. *pp.* 914–926, *Oct.*, 1934.—In solutions of $AuCl_3$ or $AuBr_3$ there is a critical current density below which regular solution of the gold anode occurs and above which it is rendered passive. Potential variations at the anodically polarised Au surface have been observed by a valve-operated oscillograph. For a given electrolyte, the product of the current in excess of the critical, multiplied by the time required for passivation is constant. The limiting current density and coulombs required for passivation are approximately proportional to the halogen-ion concentrations. Oxidising ions have little effect but in sulphate solution the gold becomes passive more readily. Vigorous stirring is necessary for reproduction of results. Anodic passivation is attributed to discharge of OH-ions and deposition on the anode of a surface layer of gold peroxide. A. S. C. L.

See also Abstracts 4380, 4383, 4477, 4632.

ELECTRONS, POSITRONS AND PROTONS.

4698. Origin of Positrons. G. Racah. *N. Cimento*, 11. *pp.* 477–481, *July*, 1934.—A calculation is given of the probability that a γ-ray of given energy in collision with a nucleus produces a positron and a negative electron and becomes completely absorbed in this process. J. J. S.

4699. Emission of Positrons from a Radioactive Source. A. I. Alichanow and M. S. Kosodaew. *Zeits. f. Physik*, 90. 3–4. *pp.* 249–265, *Aug.* 10, 1934.—Positrons were found to be emitted from lead bombarded with γ-rays from Ra C, and directly from a Ra (B + C) source. The distribution of the positrons over the energy spectrum was measured using magnetic deflection and coincidence observations with two Geiger counters. In the case of the positrons from lead, maxima in the distribution curve were correlated with the γ-ray frequencies ν at 1760 and 2200 kV in accordance with the formula $(h\nu - m_0c^2)/2$. The distribution curve from Ra (B + C) was complicated by a secondary effect, namely, the emission of positrons by β-rays from the source bombarding the Al lining used in the apparatus. Allowing for this effect, however, the experiments indicate that the direct emission of positrons from the radioactive source does not arise by internal conversion of γ-rays. Possible mechanisms suggested are direct emission from the nucleus with decrease of atomic number by unity, and materialisation of the kinetic energy of β-rays with the production in one act of two negative electrons and one positron. W. S. S.

4700. Annihilation of Positrons. E. N. Gapon. *Zeits. f. Physik*, 90. 3–4. *pp.* 279–286, *Aug.* 10, 1934.—The energy relations in the nuclear transformations of Be and B under α-particle bombardment are considered, particularly those which are accompanied by an emission of positrons. The limits of the continuous spectra of the positrons emitted by Be and B are calculated, also the limit of the spectrum of electrons emitted by Be. A value of the mass of the neutron in agreement with that found by Chadwick is deduced from an analysis of the transformations of Be and B. A possible source of error is pointed out in the value obtained by Curie and Joliot. J. E. R. C.

4701. Formulation of the Exclusion Principle in Dirac's Theory of the Positron. I. Tamm. *Phys. Zeits. d. Sowjetunion,* 6. 1–2. *pp.* 189–192, 1934. *In English.*—The electron density matrix for a system of electrons in which nearly all the states of negative energy are occupied (Dirac's theory of the positron) must obey certain conditions corresponding to Pauli's exclusion principle. These are here worked out for the relativistically generalised matrix. W. S. S.

4702. "Electric" Moment of the Electron. G. Racah. *Accad. Lincei, Atti,* 20. *pp.* 39–40, *July,* 1934.—In Dirac's second-order wave equation for the electron in an arbitrary electromagnetic field, a term appears which corresponds formally to the energy of a hypothetical imaginary electric moment of the electron. By a suitable transformation, the term in question is shown to represent the energy of the real magnetic moment of the electron in the apparent magnetic field due to the motion of the electron in the external electric field. W. S. S.

4703. Displacement of High-Series Lines of Na and K through Foreign Gases, and Calculation of Effective Cross-Section of Inert Gases towards Very Slow Electrons. C. Füchtbauer, P. Schulz and A. F. Brandt. *Zeits. f. Physik,* 90. 5–6. *pp.* 403–415, *Aug.* 21, 1934.—The positions of the maxima of lines displaced by He, Ne, A, and N were measured photometrically. For the high series there was a constant limiting value of the displacement depending only on the foreign gas. The effective cross-section towards slow electrons was calculated by Fermi's theory from these limiting values. Values agreeing with those found by Wahlin were found with He and A, but not with N and Ne; in the latter case an abnormally small cross-section was obtained. Curves are given showing a maximum of the violet displacement in the case of He and Ne. W. R. A.

4704. Measurement of Mean Inner Potential. J. R. Tillman. *Phil. Mag.* 18. *pp.* 656–675, *Sept.,* 1934.—The mean inner potentials, ϕ, of a number of single crystals have been measured, the primary electrons having energies either of about 30 kV or about 4 kV. The measurements have shown that the low and high ranges of voltage yield very nearly the same values of ϕ. Possible reasons for small differences have been discussed. Etched cleavage faces have also been examined. AUTHOR.

4705. Influence of Screening on the Creation and Stopping of Electrons. H. A. Bethe. *Cambridge Phil. Soc., Proc.* 30. *pp.* 524–539, *Oct.* 30, 1934.—The cross-sections for the emission of radiation by very fast electrons (energy great compared with mc^2) and for the production of pairs of positive and negative electrons by very hard γ-rays is calculated, considering the screening of the atomic field in which the processes happen. The main part of the paper deals with the integration of the differential cross-section over the angles. It is found that the integral cross-section increases steadily with increasing energy of the primary particle, reaching an asymptotic value for extremely high energies. [See Abstract 3411 (1934).] AUTHOR.

4706. Energy Distribution in Solids Irradiated by High-Speed Kathode Rays. R. Glocker. *Phys. Zeits.* 35. *pp.* 774–778, *Oct.* 1, 1934.—An attempt is made to explain the observations of Brasch and Langer, Glocker, and Kugler and Langendorff, that the energy distribution of high-speed (1600 kV) kathode rays in the depth of a solid medium shows a maximum value at a small distance below the surface. It is shown in a semi-empirical way that this phenomenon is a direct result of the diffusion and scattering of the canalised beam. The position of the maximum at a depth of $\frac{1}{4}$ to $\frac{1}{3}$ of the electron range, is in agreement with the calculations. The theoretically expected flattening of the maximum in heavy media such as platinum is experimentally confirmed. It is shown that, if the thickness of the absorbing medium is at least equal to the range of the electrons, the scattering absorption coefficient is independent of the velocity. J. E. R.

4707. Elastic Scattering of Kathode Rays. D. K. Froman. *Canad. J. of Research,* 11. *pp.* 156–162, *Aug.,* 1934. This paper is a continuation of Bubb's theoretical work (*Phys. Rev.* 24. *pp.* 177–189, 1924), which relates the energies and momenta of kathode rays to the properties of X-ray photons produced by them. Bubb's results are used to determine a scattering function for the kathode rays in a target in terms of the intensities of X-rays of minimum wave-length emergent from the target at various angles to the incident kathode-ray stream. It is shown that the self-consistency of Bubb's results can be tested by measurements of the intensities of two components of these X-rays polarised in mutually perpendicular planes. Mention is made of an experiment now in progress designed to test Bubb's theory by an absolute measurement using a gaseous instead of a solid target. AUTHOR.

4708. Small-Angle Inelastic Scattering of Electrons in Helium, Hydrogen and Mercury. S. N. van Voorhis. *Phys. Rev.* 46. *pp.* 480–483, *Sept.* 15, 1934.—The inelastic scattering of electrons by helium, hydrogen and mercury is measured for angles very close to the forward direction, ranging from 0° to 15° scattering. Those electrons are studied which have suffered losses of 21·1 volts, 12·6 volts and 6·7 volts, respectively, for the three gases. The initial energies range from 100 to 300 volts. The scattering per unit solid angle is found to reach a maximum at a fairly small angle and then decrease to a lower value at zero angle. The position of the maximum is a function of energy and not of momentum as predicted by the Born theory. AUTHOR.

4709. Approximate Phases in Electron Scattering. F. L. Arnot and G. O. Baines. *Roy. Soc., Proc.* 146. *A. pp.* 651–662, *Oct.* 1, 1934—A discussion of Jeffreys' approximate expression for the value of phases is given. It is shown that in the special case of the zero-order phase Jeffreys' expression is greater for a repulsive field than for an attractive field by the $\frac{1}{4}\pi$. A number of phases in krypton have been calculated by Jeffreys' and Born's approximate expressions, and these are compared with Holtsmark's exact values. The error in Jeffreys' phase is found to decrease as the order of the phase increases, and is small for all phases except that of zero order. The large error found in the zero-order phase is shown to decrease with decrease in the atomic number of the atom, and with increase in energy. The cause of this error is discussed, and it is pointed out that the error is not likely to affect seriously the form of the angular distribution curve provided the phase is itself large. Born's approximation is found to be satisfactory for phases having a value less than 0·5. A theoretical angular distribution curve is calculated for 121-volt electrons scattered in krypton, and very good agreement is obtained between this and Arnot's experimental curve. AUTHORS.

4710. Scattering of Electrons in Bromine Vapour. F. L. Arnot and J. C. McLauchlan. *Roy. Soc., Proc. A.* 146. *pp.* 662–672, *Oct.* 1, 1934. —Theoretical angular distribution curves for elastically scattered electrons of various energies from 15 volts to 339 volts are given for bromine.

These are compared with the experimental results of Arnot [see Abstract 2183 (1934)] and satisfactory agreement is obtained. Phases for various energies and an approximate Hartree atomic field for bromine are also given. AUTHOR.

4711. Scattering of Lithium Ions by a Polycrystalline Nickel Surface. A. Longacre. *Phys. Rev.* 46. *pp.* 407–410, *Sept.* 1, 1934.—Positive ions scattered by a nickel target were measured both as to energy and quantity in various directions. The ions are scattered in a forwardly directed beam whose width at one-half the maximum intensity is about 45°. The direction of the maximum is independent of the incident energy and nearly so of the angle of incidence. The ratio of the most probable energy of the scattered ions to that of the incident ions is found to decrease as the total angle of scattering increases and to be independent of the energy or the angle of incidence. To a first approximation the energy distribution is found to be the same as that for projectiles of macroscopic size undergoing elastic impacts at a rough surface with a small coefficient of restitution. AUTHOR.

4712. Electron Diffraction in Carbon Tetrachloride Vapour. V. E. Cosslett. *Faraday Soc., Trans.* 30. *pp.* 981–991, *Oct.*, 1934.—The technique of electron diffraction in vapours has been so far improved that in favourable cases orders up to the seventh can be measured. A method has been devised for eliminating the disturbing effect of the background scattering at small angles in the measurement of the diffraction photographs. The case of diffraction in CCl_4 vapour has been thoroughly investigated, both experimentally and theoretically. The theoretical scattering curve has been completely calculated, with the inclusion of a correction for the incoherent scattering. The method gives values for the Cl–Cl separation of $2\cdot 85 \pm 0\cdot 03$ Å; for the C–Cl separation $1\cdot 74 \pm 0\cdot 02$ Å. AUTHOR.

4713. Emission of Electrons under the Influence of Chemical Action. Part IV. A. K. Denisoff and O. W. Richardson. *Roy. Soc., Proc.* 146*A*. *pp.* 524–564, *Oct.* 1, 1934.—The experiments with gaseous mixtures show that the electron currents originating from chemical action are additive and exhibit saturation with true zero applied p.d. Analysis shows that the maximum energy E_m of the electrons emitted is, over the range $3 - 0\cdot 7$ volt for E_m, in satisfactory agreement with the fundamental equation $E_m = E_c - \phi$, where E_c is the energy available in the corresponding elementary chemical reaction responsible for E_m and ϕ is the work function of the metal. In this range of E_c, the number of electrons emitted per Cl atom entering into the reaction with the metal is approximately an exponential function of the chemical energy E_c. The reaction mechanism found to be of most frequent occurrence is that in which only one of the two Cl atoms of the gaseous molecule reacts with the alloy. [For Part III see Abstract 3029 (1934).] T. H. P.

See also Abstracts 4387, 4420, 4539, 4541, 4603, 4658, 4677, 4722, 4745.

ELECTROSTATICS.

4714. Effect of Temperature on the Contact Potential of Metals. G. Mönch. *Zeits. f. Physik*, 90. 7–8. *pp.* 433–439, *Sept.* 4, 1934.—Copper which had been subjected to prolonged heating in a vacuum to a temperature of 400° C., showed no change of contact potential between this and room-temperature, within an accuracy of about $\pm 0\cdot 15 \times 10^{-3}$ volt.

Care was taken to maintain the glass walls of the container at a temperature considerably below that of the metal, thus preventing the transfer of absorbed gas from the walls. The results agree better with the predictions of the Fermi-Dirac, rather than the classical, statistics. [See following Abstract.] F. C. C.

4715. Temperature Variation of the Contact Potential of a Copper Oxide Film. G. Mönch. *Zeits. f. Physik*, 90. 9–10. *pp.* 576–585, *Sept.* 6, 1934.—For a temperature range of 100° C., the change in contact potential of a Cu_2O film was found to be 0·1 to 0·15 volt in fair agreement with modern quantum electron theory of metals which predicts values of 0·1 to 0·3 volt. On the other hand, Ag_2S shows a variation of less than 10^{-2} volt for this temperature range: the reason may be that the potential jump (W_a-W_i) at the boundary Ag/Ag_2S changes with temperature by the same amount as the potential jump Ag_2S/vacuum. [See preceding and following Abstracts.] F. C. C.

4716. Contact Potential and Thermo-Potential of Cu_2O. G. Mönch. *Zeits. f. Physik*, 91. 1–2. *pp.* 124–130, *Sept.* 19, 1934.—Three measurements are made of the contact potential between the free end of a rod of Cu_2O and its surrounding evacuated Cu chamber: 1st, the rod is heated uniformly to 400° C.; 2nd, the free end of the rod is kept at constant temperature; 3rd, the temperature of the free end is raised considerably above that of the chamber. The results obtained for the first case were in agreement with previous work [see preceding Abstract]. For the 2nd case the change in contact potential is found to be equal to the thermo-potential for the elements $Cu/Cu_2O/Cu$ for the observed temperature difference of the junctions. The 3rd case amounted to the sum of the first two cases. In general, however, the thermo-potential is not directly determined by the temperature variation of the contact potential. F. C. C.

See also Abstract 4676.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4717. Measurement of Transverse Thermomagnetic Effect. G. S. Nielsen. *Phil. Mag.* 18. *pp.* 575–579, *Oct.*, 1934.—The Nernst-Ettingshausen effect is attributable to (*a*) direct action of the magnetic field on the electrons in the metal and (*b*) to an indirect effect due to polarised molecules. Apparatus for separately determining these two effects is described. Results with a nickel tube show that the coefficient for effect (*b*) is 0·15 K, where K is the coefficient of heat conduction. The effect (*a*) was too small to determine. J. S. G. T.

MAGNETISM AND ELECTROMAGNETISM.

4718. Classical Model of Ferromagnetics, and its Quantisation in the Region of Low Temperatures. G. Heller and H. A. Kramers. *K. Akad. Amsterdam, Proc.* 37. 7. *pp.* 378–385, 1934.—A classical model of a ferromagnetic is discussed; a space lattice model alone is characterised by ferromagnetic saturation; quantisation gives accurately the formulæ of Bloch and of Møller. J. S. G. T.

4719. Kathode-Ray Oscillograph Study of Magnetisation of Ferromagnetic Substances. P. Bricout and R. Salomon. *Comptes Rendus*, 199. *pp.* 529–531, *Aug.* 27, 1934.—Two similar transformers with their primaries in series are supplied with a.c. of constant frequency and p.d. One pair of plates of the oscillograph is connected to the ends of a non-inductive resistance in series with the primaries, and the other pair when connected to one of the secondaries gives a closed curve of the induced e.m.f. as a function of the field in the primary during a cycle of magnetisation. By the use of a synchronous commutator, two curves are obtained which are identical only when the primary cores are magnetically identical. This arrangement has been used to detect differences in steels of the same composition whose temperatures of annealing differed by a few degrees. G. E. A.

4720. Large Barkhausen Discontinuities and Their Propagation in Ni-Fe Alloys. Part II. R. E. Reinhart. *Phys. Rev.* 46. *pp.* 483–486, *Sept.* 15, 1934.—The relationships between longitudinal field, intensity of magnetisation and velocity of propagation of large Barkhausen discontinuities have been investigated. For a constant velocity of propagation a linear relation has been found between intensity of magnetisation and longitudinal field. The curves relating velocity and intensity of magnetisation for a fixed value of longitudinal field resemble velocity-longitudinal field curves. The relationships between longitudinal field, circular field and the directions of strain axes have been investigated for pure nickel wire under combined torsional and tensile stresses. It has been found that only the component of field in the direction of maximum compression affects the velocity of propagation. The behaviour of propagation phenomena for pure nickel is just the reverse of that observed for a 10 per cent Ni-Fe alloy. This difference is probably related in some way to the difference in magnetostrictive properties of the two wires. [For Part I see Abstract 2200 (1934).] AUTHOR.

4721. Effect of Nascent Hydrogen on the Magnetic Properties of Iron. R. K. Reber. *Physics,* 5. *pp.* 297–301, *Oct.,* 1934.—Hydrogen was electrolysed into flat ring kathodes of magnetically soft iron in 0·5 *N* solutions of H_2SO_4 or of KOH. The design of the electrolytic cell permitted magnetic testing at intervals. Magnetic hardening began after many hours provided the electrolytic current density was kept above a lower limit depending on the electrolyte. This hardening proceeded, at adequate current density, to an end point beyond which longer charging at any current density rarely produced any further changes in magnetic properties. Removal of hydrogen by storage in air at room-temperature for 5 months, or by annealing at 400° C. in vacuum for 17 hr., did not diminish the magnetic hardness produced during electrolysis. It is suggested that the iron is locally cold-worked by non-uniform distribution in it of hydrogen in excess of the solubility limit at room temperature, and that uniformly distributed hydrogen up to this limit has very little effect on the ferromagnetic properties. AUTHOR.

4722. Diamagnetism of the Dirac Electron. T. Muto. *Inst. Phys. and Chem. Research, Sci. Papers, No.* 509. *pp.* 165–170, *Aug.,* 1934. *In English.*—It is shown that the diamagnetic property of Dirac's electron may be given by a term in the wave-equation which has been neglected in Dirac's paper because it contained the square of the field strength. The result may approach that for Schrödinger's electron in the non-relativistic approximation. G. E. A.

4723. Magnetic Susceptibility of Hydrates of Magnesium Sulphate and Magnesium Salts. E. Duchemin. *Comptes Rendus,* 199. *pp.* 571–573, *Sept.* 10, 1934.—Susceptibility measurements are given for $MgSO_4.H_2O$, $MgSO_4.2H_2O$, $MgSO_4.7H_2O$, $MgSO_4.K_2SO_4$, $MgSO_4.K_2SO_4.6H_2O$, $MgSO_4.(NH_4)_2SO_4.6H_2O$. in the solid state. In the case of the last two substantial agreement is shown between observed values and those calculated on the additivity principle, while, for the first four, the experimental are considerably lower than the calculated values, indicating instability of the complexes in the solid. N. M. B.

4724. Atomic Diamagnetic Susceptibility of Hydrogen. S. S. Bhatnagar, N. G. Mitra and G. D. Tuli. *Phil. Mag.* 18. *pp.* 449–456, *Sept.*, 1934.—The value of χ was determined for the CH_2 group from the susceptibilities of a large number of homologous series of aliphatic and aromatic compounds. Pascal's value for carbon, $-6\cdot00\times10^{-6}$, was subtracted from the result, and the atomic susceptibility of hydrogen deduced. The value found for χ_H was $-2\cdot68\times10^{-6}$; Pascal's value was $-2\cdot98\times10^{-6}$, and that calculated from the new quantum mechanics is $-2\cdot37\times10^{-6}$. G. E. A.

4725. Constant Current in Magnetic Field. L. Lombardi and E. Bottani. *Accad. Lincei, Atti*, 19. *pp.* 840–844, *June* 17, 1934.—A continuation of previous work [see Abstract 4348 (1934)] giving methods and results of experiments. The distribution of a continuous current in a homogeneous conductor remains practically unaltered under the influence of external permanent magnetic fields, except for the small deformations, that may arise under limiting conditions, in the equipotential surfaces and in the lines of current under the Hall effect. A. D.

4726. Powder Figures on Magnetised Iron Crystals. S. Kaya. *Zeits. f. Physik*, 90. 7–8. *pp.* 551–558, *Sept.* 4, 1934.—The author's earlier work [see Abstract 3935 (1934)] on the powder figures obtained on the cube faces of a magnetised iron crystal is extended to an examination of the dodecahedral and octahedral faces. The type of figure obtained depends on the degree of magnetisation of the crystal. Four types are distinguished and the relations between them investigated. H. J. H. S.

4727. Forces between Magnets and the Law of Inverse Squares. E. J. Irons. *Am. Phys. Teacher*, 2. *pp.* 113–114, *Sept.*, 1934.—The forces between two identical magnets at various distances apart and with both like and unlike poles adjacent, are measured by direct weighing when the magnets are (*a*) in line, and (*b*) form two opposite sides of a rectangle. Experimental details are given and the pole strengthens of the magnets are calculated for each distance of separation; the abnormal values deduced when the magnets are near together being explained qualitatively and mainly in terms of induction. The attraction between a magnet and a demagnetised bar of the same dimensions is also measured. AUTHOR.

4728. Selecting an Inductometer Scale. N. F. Astbury. *Journ. Sci. Instruments*, 11. *pp.* 319–320, *Oct.*, 1934.—In mounting a moving coil to give a variation of 1 % or so on a mutual inductance, it is necessary to determine at least two quantities—the length of the arm carrying the moving coil and the separation of its axis of rotation from the axis of the fixed coil. A simple method is described for the simultaneous determination of these quantities, only one preliminary set of experimental results being necessary. A simple reciprocal property is pointed out which leads to an improvement in mechanical design. AUTHOR.

See also Abstracts 4434, 4446.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4729. Use of Progressive Currents. L. Delherm, Fischgold and Strouzer. *J. de Radiologie et d'Électrologie*, 18. *pp.* 427–430, *Aug.*, 1934.—Deals with the response of muscular tissue to current which is progressively increased and applied according to a method, developed in 1915 by Lapique, utilising the discharge of a condenser. The phenomenon is utilised, practically, to determine the reaction of degeneration of muscular tissue, eight examples with corresponding current curves being given for human subjects and the diagnostic importance of the method is discussed generally. B. J. L.

4730. Determination of Cardiac Function, by Means of the Kymograph. L. Delherm, P. Thoyer-Rozat and Fischgold. *J. de Radiologie et d'Électrologie*, 18. *pp.* 505–514, *Oct.*, 1934.—The kymograph is an instrument, by which the movements of the heart and other moving organs are recorded upon a moving photographic strip via a slit aperture. The development of this instrument is due to a number of investigators and the various types are briefly reviewed, without detailed description. The remainder of the paper is purely medical, dealing with the movements of particular regions of the heart and related vessels, illustrated by typical strip records and curves obtained therefrom. B. J. L.

4731. Biological Effect of H.F. Fields. H. Dänzer. *Ann. d. Physik*. 20. 5. *pp.* 463–480. *Aug.*, 1934.—An attempt is made to formulate a theoretical basis for the considerable experimental knowledge of the behaviour of biological objects in h.f. electrical fields. The theory of the relationship between the energy absorption in inhomogeneous dielectrics has been developed by Wagner from an electrotechnical standpoint. The purpose of the present paper is to adapt this theory to the biological problem. The particular biological substance considered is blood. Wagner has studied the case of a medium in which small homogeneous spheres of different dielectric constant and conductivity are embedded. A similar structure is assumed for blood, except that the suspended particles consist of a membrane containing a liquid nucleus, the conductivity of the membrane being much smaller than those of the liquids. A detailed mathematical analysis of this case is made, and the dielectric constant and conductivity calculated. No evidence is found to support the experiments of Schaeffer, who found that in the wave-length region 3–6 m., the h.f. conductivity increases considerably. J. E. R.

4732. Compensating Pantograph for Obtaining Actual Size Tracings of the Heart with the Roentgenoscope. G. Levene, F. E. Wheatley and Helen Matthews. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 411–414, *Sept.*, 1934.—Owing to the relative approximation of the source of radiation, the object and the shadow, in X-ray measurement of the size of the heart, distortion occurs. This may be overcome by special methods, either costly, or tedious. The authors illustrate a pantograph, which allows correction of the image, as seen upon the normal X-ray screen. B. J. L.

4733. Wall Absorption and Buckling Strength of Cylindrical Radium Containers. G. W. C. Kaye, G. H. Aston and W. E. Perry. *Brit. J. of Radiology*, 7. *pp.* 540–556; *Disc.*, 556–557, *Sept.*, 1934.—Corrections to be applied to the measured "effective" contents of uniformly filled radium tubes and needles, of platinum and monel metal of external diameters 1·5 to 8 mm. and wall thicknesses from 0·3 to 1·5 mm. are given. The corrections range between 4 and 22 % for platinum tubes and between 1 and 4 % for monel metal tubes. It is shown that the corrections are higher for partially filled tubes than for completely filled tubes. The buckling strengths of 10 % iridio-platinum needles under end-wise loading were found experimentally to be proportioned to the fourth power of the external diameter and inversely to the square of the length. The buckling strength is nearly doubled by increasing wall thickness from 0·4 to 0·5 mm., and nearly trebled by increasing it from 0·4 to 0·6 mm. Lateral loading markedly reduces the buckling strength. G. E. B.

4734. Ultra-Violet Emission Coefficient for Tungsten at High Temperatures. F. Hoffmann and H. Willenberg. *Phys. Zeits.* 35. *pp.* 713–715, *Sept.* 15, 1934. *From the Reichsanstalt.*—For many purposes particularly in work on the biological action of ultra-violet radiations, it is desirable to know the ultra-violet emission coefficient, $e_{\lambda T}$ of tungsten, for a reasonably wide spectral range; hence, from a knowledge of the temperature and surface area of the tungsten emitter, the quantitative spectral distribution can be deduced. The light from a tungsten filament lamp with a quartz window was passed through a quartz monochromator on to a gas-filled cadmium cell. The filament was maintained at 2900° Abs. By means of a rotating sector the radiation was compared with the emission from a black body. Tables of $e_{\lambda T}$ are given for the range 2600 to 6800 Å; in the visible region comparable values, obtained with a spectrophotometer, are given. The results are in good agreement with those of Hulbert and of Worthing, obtained over a smaller range. Probable errors in the measurements are discussed in detail. J. E. R.

4735. Physical Aspects of Various Qualities of Radiation. R. S. Landauer. *Am. J. of Roentgenology and Radium Therapy*, 32. *pp.* 235–238, *Aug.*, 1934.—Of recent years, in the U.S.A., X-ray installations up to 600,000 volts have been installed for therapeutic purposes. The author discusses the economics of such installations, as compared to lower voltage installations. He is of opinion that, as compared to a 4-gm. radium bomb, a 200,000 volt X-ray installation is more economical and, for an equivalent dosage, 12 gm. of radium would be required at a cost of $720,000. A 600,000 volt X-ray apparatus is still more superior to the radium bomb. Whilst, with a radium bomb, a 65 % depth dose is theoretically obtainable, this would require 180 grams of radium at a cost of over ten million dollars. The opinion is therefore formed that progress is in the direction of very high voltage X-ray apparatus, although, with increasing voltage, the cost of such apparatus rapidly increases. The final decision must be based on actual clinical results, since incidental factors, other than depth dosage, have to be considered. B. J. L.

4736. Use of the Sheard-Sanford Photelometer in the Determination of Small Quantities of X-Rays. E. I. L. Cilley and E. T. Leddy. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 408–410, *Sept.*, 1934.—The Sheard-Sanford photelometer has been utilised to measure the percentage of light transmitted by films, and, therefore, as a method of evaluating the degree of blackening of X-ray film, for the purposes of dosage measurement. The instrument is very rugged in construction, but the results of tests show definite variations in respect to the particular photographic film material used. The method is very sensitive, erythema doses between 0·00003 and 0·001 being easily evaluated. Between 0·0001 and 0·001 erythema dose, readings are readily made with a high degree of accuracy and very close agreement. The instrument is suggested as being rugged, simple, easy to use and accurate, and, therefore, of value as a precision method of measuring small quantities of X-rays. B. J. L.

4737. Dosage Measurement of Very Soft X-Rays (Grenz Rays.) R. Jaeger. *Phys. Zeits.* 35. *pp.* 665–682, *Sept.* 1, 1934. *From the Reichsanstalt.*—Ionisation measurements suitable for medium and hard X-rays, are not directly applicable to Grenz rays. The present paper deals in detail with the applicability of such measurements in respect to ionisation chambers, with an extended mathematical discussion illustrated by various curves. The actual ionisation chamber used and its connection is described together with the method of producing soft X-rays at 10 kV. The relationships between small and large standard ionisation chambers, as used in practice, are then discussed for homogeneous and non-homogeneous radiation, from a mathematical aspect. A coefficient absorption by the air of the ionisation chamber, and its determination by means of cellophane are discussed. Finally mathematical relationships are deduced to allow correct measurements of these very soft rays by both small and large ionisation chambers. An extended Bibliography of the subject matter is given. B. J. L.

4738. Safety Measures in X-Ray Work, Including H.T. Flexible Cables. L. G. H. Sarsfield. *I.E.E., J.* 75. *pp.* 253–270; *Disc.*, 270–277; *Sept.*, 1934.—After a discussion on the conditions governing fatal injury by electric shock, an account is given of the electrical characteristics of X-ray plants, both from the l.t. and h.t. points of view. Safety measures are considered in some detail, and the various arrangements for partial and total enclosure of dangerous components are examined, examples being given. Flexible h.t. cables are described and various precautions to be observed in " making off " the ends are given. Finally, protective recommendations issued in various countries are reviewed. In the *Discussion*, **V. E. Pullin** stressed the importance of safety in medical and industrial radiology, and showed that shockproof h.t. equipment of considerable power could now be made portable; **G. W. C. Kaye** summarised the history of protective recommendations and their influence on design; **W. V. Mayneord** discussed some medical aspects of shockproofing; **B. J. Leggett** argued against the use of X-rays by unskilled workers in either medical or industrial fields. **C. M. Davies** discussed some installation details; **G. E. Bell** pointed out that the problem of earthing X-ray equipment was fraught with conflicting considerations; **A. Beetlestone** showed that complete X-ray and electrical protection could be provided in continuously evacuated equipment; and **F. C. Raphael** made the case for enclosing all h.t. conductors and earthing all apparatus, and also discussed some difficulties in regard to signal lamps. G. E. B.

4739. X-Ray Protection. E. T. Leddy, E. I. L. Cilley and B. R. Kirklin. *Am. J. of Roentgenology and Radium Therapy*, 33. *pp.* 360–368, *Sept.*, 1934.—The technique of gastric X-ray examinations, as carried out at the Mayo clinic, is reviewed in respect to the dangers to the operator. in the procedure of palpation. Lead rubber and leather gloves have been used and the latter offer a negligible protection. In the case of three physicians, who have each made approximately 40,000 gastric examinations, although each has been submitted to radiation several times that of the tolerance dose, as defined by Mutscheller, no injurious effects have been discovered, although the authors point out, this cannot be accepted as definite, since late effects are known to occur. In measuring the dose obtained in the particular operations, by the ionisation and the photographic methods of measurement, disagreement as to the actual dosage is found, doubtless due to the inherent errors of both methods. Although the recommendations of the International Safety Committee appear excessive in some respects, the authors advise continuance of their observance. B. J. L.

4740. Gurwitsch Radiations. L. K. Wolff and (Miss) G. Ras. *K. Akad. Amsterdam, Proc.* 37. 7. *pp.* 430–445, 1934. *In French.*—A large number of experiments on the Gurwitsch phenomena of mitogenetic rays are described. It is found that rays transmitted through crystalline quartz are much more biologically effective than direct rays. It is suggested that this is due to polarisation of the mitogenetic radiation, polarised rays giving a larger biological effect. Amorphous quartz does not affect the radiations. Other crystalline substances besides quartz have an accelerating effect. It is suggested that these results explain the effect of the wall of the vessel containing the biological medium, on the " lag time " of the Gurwitsch phenomenon. J. E. R.

See also Abstracts 4611, 4706.

OSCILLATIONS.

4741. Non-Linear Theory of Electric Oscillations. B. van der Pol. *I.R.E. Proc.* 22. *pp.* 1051–1086, *Sept.*, 1934.—This paper deals with the physical and mathematical aspects of several oscillator circuits, using the non-linear valve characteristic equation to obtain additional information as compared with the more familiar linear method. Differential equations associated with the phenomena are stated and solved for the following : (*a*) free oscillations of regenerative triode oscillator ; (*b*) triode oscillator with two degrees of freedom ; (*c*) triode oscillator with external e.m.f. ; (*d*) relaxation oscillations ; and (*e*) systems producing relaxation oscillations under the influence of an impressed periodic e.m.f. A very complete Bibliography is appended. G. A. V. S.

4742. Voltage Stabiliser Controlled by a Pentode. Robley D. Evans. *Rev. Sci. Instruments*, 5. *pp.* 371–374, *Oct.*, 1934.—A voltage stabilising circuit employing one pentode and one standard 45-V dry battery is described. When used in connection with a conventional a.c. and d.c. rectifier the stabiliser fully compensates for fluctuations in the a.c. mains and provides a d.c. output of zero to several thousand volts in which the fluctuations are less than 1 part in 5000. No current is drawn from the dry battery, hence its useful life is a year or more. Circuit constants are given for stabilisers supplying 85, 135, 600, 1000 and 1400 V at currents from 15 to 0·5 mA. A general theory of all similar triode, tetrode and pentode stabiliser units is derived, and the impracticability of eliminating the single dry battery is pointed out. AUTHOR.

See also Abstracts 4639, 4719, 4766.

PHOTOELECTRICITY.

4743. Photoelectric Effect of Very Thin Films of Organic Molecules at the Interface Water-Air. H. Cassel and E. Tohmfor. *Zeits. f. Physik*, 90. 5–6. *pp.* 427–432, *Aug.* 21, 1934.—The photoelectric effect of very thin films of aniline, diphenylamine and triphenylamine at the interface water-air is measured as a function of the surface density and the time of illumination. The results are expressed in the form of curves showing the dependence of initial photoelectric current, obtained by extrapolation from the observed values, upon the number of molecules per unit area. The curve for aniline is a straight line, which is explained as due to the fact that the distribution in the film is disperse. For di- and triphenylamine the slope of the curve changes abruptly at a certain point. This is explained as due to a change over at this point from a monomolecular crystalline film to some new distribution. In support of this view it is found that neither di- nor tri-phenylamine has any appreciable effect upon the surface tension; also ultra-microscopic observation of quartz powder scattered on the film indicates the presence of a regular crystalline distribution. The point of change of slope of the current-surface density curves leads to an estimate of the area taken up by each molecule in the monomolecular films. L. A. W.

4744. Influence of Gases on the Photoelectric Effect of Platinum. E. Schaaff. *Zeits. f. phys. Chem.* 26. *Abt.B.* 6. *pp.* 413–427, 1934.—Using a cell protected from grease vapours, etc., the effect of successive heating in a high vacuum and of treatment with gases upon the photoelectric effect of platinum is investigated. Successive heating is found to cause at first an increase of photoelectric sensitivity together with a displacement of the red threshold towards longer wave-lengths, then later a decrease of sensitivity and a reversal of the threshold displacement. The threshold eventually passes below the lowest wave-length used, namely 2262 Å. Treatment with H_2 alone or O_2 alone produces no observable effect; but when the Pt foil is alternately glowed in H_2 and O_2 the O_2 produces a lowering of sensitivity and displacement of the threshold to shorter wave-lengths, these effects being neutralised by the H_2. It is further found that water increases the photoelectric sensitivity, that CO has no effect, and that CO_2 acts similarly to O_2. The mechanism of these phenomena is discussed. L. A. W.

4745. Photoelectrons Expelled from Elements by Chromium K-Radiations. H. R. Robinson. *Phys. Soc., Proc.* 46. *pp.* 693–702, *Sept.* 1, 1934.—Earlier work on the magnetic spectroscopy of X-ray electrons [see Abstracts 4038 (1930) and 353 (1934)] is extended by the use of X-rays of longer wave-length than those previously employed. Groups of photoelectrons ejected from targets of Au, Pt, W, Sm, La Sn, Ag and Cu by Cr K-radiations has been photographed, and their energies are tabulated and compared with the values to be expected from X-ray data. The relative intensities of the groups and other details of their appearance are briefly discussed. AUTHOR.

4746. Spectral Distribution of the Photoelectric Effect in Copper Oxide. Anne and A. Joffé. *Comptes Rendus*, 199. *pp.* 569–571, *Sept.* 10, 1934.—Spectral distribution curves are obtained showing that the positions of the maxima depend on the thickness of the oxide layer. This explains the former anomaly of the difference in the spectral distribution of the photoconductivity and of the photoelectric effect. N. M. B.

4747. Effect of Adsorbed Oxygen on the Photoelectric Emissivity of Silver. A. K. Brewer. *Am. Chem. Soc., J.* 56. *pp.* 1909–1913, *Sept.*, 1934.—Oxygen is shown to have three distinct effects on the work function of clean silver, as determined by means of photoelectric emission. (1) At room-temperature the presence of oxygen slightly enhances the emissivity, the effect disappearing with the removal of the oxygen. (2) After heating in oxygen the silver upon heating *in vacuo* possesses abnormally large emissive properties, the effect only disappearing after long heating. (3) Heating in oxygen or exposure to ozone destroys the emissivity. The effects observed under (1) and (2) have been associated with " physical " and " activated " adsorption respectively while (3) is due to the presence of " surface " silver oxide. Evidence is presented to show that the lowering of the work function by " physical " and " activated " adsorption is due to positive oxygen ions, while the increase in the work for electron emission brought about by " surface " silver oxide is due to negative oxygen ions. AUTHOR.

4748. Luminous Discharge in Gas-Filled Photoelectric Cells. F. Rother and H. Bomke. *Phys. Zeits.* 35. *pp.* 703–705, *Sept.* 1, 1934.—The conditions governing the appearance in an illuminated gas-filled photoelectric cell of a glow, at voltages well below that at which the usual self-maintained glow-discharge occurs, are investigated. This glow is due to emission of light from the gas molecules excited by collision with the primary photoelectrons. It is found that the glow appears when the current in the cell reaches a certain critical value, provided that the applied voltage is above the ionisation potential of the gas. There is no dependence upon the geometrical form of the cell. D. H. F.

4749. Optical Factors in Cs-Ag-O Photoelectric Cells. H. E. Ives and A. R. Olpin. *J.O.S.A.* 24. *pp.* 198–205, *Aug.*, 1934.—The object of the experiments here described is to determine whether the selective maximum of emission exhibited by Cs-Ag-O photo cells at 8000Å is due to an intrinsically greater emissive power of the surface at that wave-length or to optical effects associated with the thickness of the oxide layer, and the plane of polarisation and angle of incidence of the exciting light. Kathodes were constructed on specular silver plates in such a way that their specular character was retained in the final sensitive surface. They were regarded, for the purpose of theoretical computation, as silver surfaces, overlaid with a thick layer of refracting material, with a thin photosensitive layer on the top of that. The variation of the photoelectric emission with angle of incidence, plane of polarisation and wave-length of the exciting light were found to accord in general with the variations of energy density at the sensitive surface which would follow, from purely optical considerations, from such an assumption. But there was always superposed on these variations a maximum of emission at 8000Å. which could only be accounted for as being due to an intrinsically greater emissive power of the surface at this wave-length. Several explanations of the origin of this are discussed. [See Abstract 2952 (1933).] D. H. F.

4750. Photoconductivity of Thin Metal Films. Q. Majorana. *Phys. Zeits.* 35. *pp.* 740–744, *Sept.* 15, 1934.—Experiments are described in confirmation of the results reported previously by the same author [see Abstract 1236 (1933)]. Thin films of various metals were connected in series with a battery and the primary of a transformer, and the secondary connected to an amplifier; on intermittent illumination of the film a periodic increase of resistance occurred and a note was produced in a telephone in the amplifier. This could be balanced out by the current from a photocell also connected in series with the primary of the transformer and similarly illuminated. It was shown that the resistance change was out of phase with the illumination by about 45°. The effect was most marked with Pt, Ag, Au and Sn; Al and Zn gave only a slight effect and Na gave none at all. With a burnt-in film of Pt on glass the effect was still obtained when the film was immersed in water; it was less than in air and was of the same magnitude whether the water was flowing or still. The effect was still obtained with an intermittency of 16,000 ∼. It is concluded that the effect is partly thermal in origin and partly due to a new photoelectric effect. D. H. F.

4751. Photovoltaic Cells Containing Dye Solutions. B. S. V. R. Rao. *J. Phys. Chem.* 38. *pp.* 693–700, *May*, 1934.—From a study of the photovoltaic effects in aqueous solutions of erythrosin and chrysoidine, it is shown that (1) the usually observed maximum in the potential-concentration curve is to be attributed to the absorption of the active radiation in the column of the electrolyte in front of the electrode ; (2) the photopotential varies directly as the square root of the intensity of light ; (3) wave-lengths immediately following the long-wave limit of the absorption band of the dye are most active in producing these potentials. AUTHOR.

4752. Copper Oxide Photoelectrolytic Cell. W. E. Meserve. *Physics*, 5. *pp.* 244–249, *Sept.*, 1934.—One electrode of a cell consisting of Cu_2O-on-Cu electrodes immersed in 1 % lead-nitrate solution was exposed to sinusoidally varying illumination, and the open circuit e.m.f. was studied. The results agreed closely with those calculated from the equivalent electrical network whose elements have values corresponding to those of the cell as measured on the a.c. bridge, if it is assumed that electrons are liberated at the Cu-Cu_2O surface in the same way as in the dry Cu_2O rectifier photocell. It is thus concluded that the photoactivity of the cell can be explained in the same manner as that of the dry Cu_2O cell, except that the electrolyte takes the place of the front electrode in making contact with the oxide. D. H. F.

4753. Photo-Planimeter. S. Gradstein. *Rev. Sci. Instruments*, 5. *p.* 311, *Sept.*, 1934.—The simplified device described is based on the principle of Gray's photoelectric integraph [see Abstract 4315 (1931)]. Light from a suitable source passes through a diaphragm and falls on a photoelectric cell ; the area of an opaque object is determined from the diminution of the current from the cell when the object is interposed between the light and the diaphragm. N. M. B.

See also Abstracts 4405, 4406, 4407, 4419, 4485, 4501, 4624, 4625, 4713.

PIEZOELECTRICITY.

4754. Inverse Piezoelectric Properties of Rochelle Salt. C. I. Vigness. *Phys. Rev.* 46. *pp.* 255–257, *Aug.* 15, 1934.—The relation between the change of lattice spacing of the (021) planes of Rochelle salt as a function of the change in voltage applied along the a-axis of the crystal has been determined by X-ray methods over the temperature range from approximately 10° C. to 30° C. Measurements with a microscope of the strain set up in the crystal, due to a change in voltage applied along the a-axis, indicate that there is a one to one correspondence between the change of lattice constant as measured by X-rays and as determined from the measurements of strain. The piezoelectric modulus, d_{14}, as determined by the inverse piezoelectric effect is larger than the values determined from the piezoelectric effect. AUTHOR.

4755. Temperature-Coefficient of Quartz Oscillators. H. Straubel. *Phys. Zeits.* 35. *pp.* 657–658, *Aug.* 15, 1934.—The method hitherto used for reducing to less than 1 in 10^6 per °C. the temperature-coefficient of frequency of quartz oscillators consists in adjusting to the suitable value the ratios of the thickness to the other dimensions of the quartz plate. This method labours under the disadvantage that the coefficient is small over a temperature range of a few degrees only. A better method is to cut the plate from the mother crystal in either of two orientations inclined to the usual orientations. The coefficient is then independent of the dimensions and shape of the plate, and remains smaller than 1 in 10^6 per °C. over a range of about 100° C. P. V.

4756. Streak Method of Making Oscillations of Quartz Visible. V. Petržílka and L. Zachoval. *Zeits. f. Physik*, 90. 9–10. *pp.* 700–702, *Sept.* 6, 1934.—A quartz plate is made to oscillate by electrical means and convergent light from a point source is passed through it, and after passing through a focus, forms an image of the plate by a lens on a screen. A shutter is introduced at the focus and, when the plate is oscillating, light streaks are seen on a dark background due to double refraction. From the diagrams it is clearly shown that the optical properties of the quartz plate are directly dependent upon the electrical as well as the mechanical components of potential. H. M. B.

4757. X-Ray Study of a Long X-Cut Quartz Crystal Vibrating Under the Transverse Piezoelectric Effect. M. Y. Colby and S. Harris. *Phys. Rev.* 46. *pp.* 445–450, *Sept.* 15, 1934.—The sixth order reflection from the (110) set of planes of a long X-cut quartz crystal of the $K\alpha$ radiation of Mo was photographed for the following conditions: (1) with the crystal non-oscillating, (2) with the crystal oscillating at its fundamental frequency under the transverse piezoelectric effect, and (3) with the crystal oscillating at its second harmonic frequency. From the microphotometer analysis of these lines it is shown that no increase in width of the lines reflected from the crystal oscillating at its fundamental frequency over the width of the lines reflected from the non-oscillating crystal is observed. This fact shows that there is no elastic deformation of the spacing of the (110) set of planes greater than $1\cdot45 \times 10^{-5}$ per unit dimension. This value is the limit of the sensitivity of the spectrograph and microphotometer used. However, an appreciable increase in intensity in the lines reflected from the crystal oscillating at its fundamental frequency over the lines reflected from the non-oscillating crystal is shown. A microphotometer analysis of Laue spots obtained by passing a rectangular beam of X-rays through the middle of the crystal when it was oscillating at its fundamental frequency confirms the prediction made by the authors [see Abstract 2157 (1933)]. The results seem to indicate that any increase in intensity of the reflected X-rays from any portion of a quartz crystal produced by piezoelectric oscillations of the crystal is due almost entirely to a reduction of secondary extinction. AUTHORS.

4758. Piezoelectric Properties of Quartz and Tourmaline. G. W. Fox and G. A. Fink. *Physics*, 5. *pp.* 302–306, *Oct.*, 1934.—The piezoelectric properties of quartz and tourmaline have been investigated through a study of the converse piezoelectric effect. In the case of quartz, the piezoelectric constant has been measured from point to point across the specimen. Considerable variation in the " constant " has been observed in different samples of quartz. Attention is called to difference between the motions of piezoelectric plates when subjected to static electric fields and when subjected to alternating electric fields. AUTHORS.

See also Abstract 4642.

THERMIONICS.

4759. Statistics of Thermionics. A. Gehrts. *Phys. Zeits.* 35. *pp.* 692–699, *Sept.* 1, 1934.—Richardson's law was obtained under the assumption of the existence within the metal of " free " electron gas, using the Maxwellian velocity distribution for the free electrons. Recently Sommerfeld has shown that in obtaining the law for the thermal emission of electrons, the Fermi statistics and not those of Maxwell should be employed. It is here shown that Sommerfeld's work renders it unnecessary to assume the existence of a free electron gas within the metal. Taking the Fermi relation as a basis and making use of Planck's result that an elementary system (atom) consisting of an electron and a restatom, is an oscillator with three degrees of freedom for energy reception and the energy content in each degree of freedom must be an integral multiple of the quantum, the law of thermal emission of electrons can be deduced without assuming a free electron gas within the metal. The law thus obtained is the same as that of Sommerfeld, but for a factor 2 for the electron twist and a factor $(1 - r)$ for the electron reflection. For the electron exit work an expression with two terms is obtained, as with Sommerfeld, and the second subtractive member is shown to be related to the zero energy condition of Nernst. A. W.

4760. Calculation of External Work Function from Compressibility. H. Bomke. *Zeits. f. Physik*, 90. 7–8. *pp.* 542–550, *Sept.* 4, 1934.—It is shown that a simple relation exists between the external work function and the compressibility of metals, and a formula is given whereby the value of the work function can be calculated from simple material constants. It is further shown that there is a fundamental significance in the classification of metals into two groups suggested by Rother and the author [see Abstract 1757 (1934)]. It becomes possible in the light of the present work to allot metals unambiguously to the proper groups in cases where a decision was previously impossible. L. A. W.

4761. Tungsten-Thorium Problem. E. Chalfin. *Phys. Zeits. d. Sowjetunion*, 5. 6. *pp.* 838–847, 1934. *In German.*—It is shown that the anomalies of the activation of thorium-containing tungsten are to be imputed to fluctuations of the distribution of the Th atoms on the surface of the W. Thence it follows that the electron emission of a W surface containing Th depends not only on the number but also on the distribution of the Th atoms on the surface. The calculation of the surface covering according to Langmuir's formula is possible only when the activation curve is normal. In the anomalous region the formula gives random and invariably larger values than the true value of the surface covering. J. J. S.

4762. Ionisation of Alkali Atoms on Tungsten, Molybdenum and Thoriated Tungsten. L. Dobrezow. *Zeits. f. Physik*, 90. 11–12. *pp.* 788–801, *Sept.* 17, 1934.—Measurement was made of the thermal ionisation of Na vapour on W and Mo at various temperatures, and of Na and K on W coated with Th at various temperatures and amounts of surface covering. It was found that the dependence on temperature of the surface ionisation of K and Na on W and Mo is well expressed by the Langmuir-Saha formula. On Th-coated W, so long as the amount of surface covering, θ, is $< 0 \cdot 6$, the dependence on temperature of the surface ionisation of Na is the same as on pure W; the dependence on temperature of the surface ionisation of K changes only slightly with change of θ. These phenomena may be explained on the hypothesis that on the surface of the wire with $\theta < 1$ patches of pure W exist, on which almost exclusively the ionisation takes place. J. J. S.

See also Abstracts **4711, 4713.**

THERMOELECTRICITY.

4763. Theory of Steady Currents in Metallic Conductors. F. Odone. *N. Cimento*, 11. *pp.* 361–371, *June*, 1934.—Duhem's theory of thermoelectric effects based on thermodynamics together with certain special hypotheses, is re-examined and an error in Duhem's analysis is corrected. For the e.m.f. (vector) at a point in a volume conductor Duhem's expression $E = -(\text{grad } V + \text{grad } \theta_T)$ must be replaced by $E = -\left(\text{grad } V + \text{grad } \theta_T + \frac{\partial\theta}{\partial T} \text{grad } T\right)$ where V is the electrostatic potential, T the temperature and θ another potential function corresponding to interaction between material masses and electric changes. It follows that Duhem's expression for the Thomson heat is incorrect and his relation between the Thomson coefficients $\mu_a(T)$ and $\mu_b(T)$ of two metals, *a* and *b*, and the Peltier effect at their junction $P_a^b(T)$, *viz.*, $\mu_a(T) - \mu_b(T) = J\,T \frac{\partial}{\partial T}\left[\frac{P_a^b(T)}{T}\right]$, must be replaced by $\mu_a(T) - \mu_b(T) = J \frac{\partial}{\partial T}[P_a^b(T)]$, where J is the mechanical equivalentof heat. W. S. S.

4764. Thermoelements with Curved Characteristic. G. Keinath. *A.T.M.* 4. *p.* 97, *July*, 1934.—A discussion is given of the behaviour of thermoelements with curved characteristic described by Kulbusch and Kalinin and previously investigated by Robn. Alloys of Ni with 10 % Cu and 10 % Fe were examined by Robn, and other similar alloys of Ni with more Fe and Cu were described by Kulbusch. In these elements the e.m.f. increases slowly at first and not proportionally to the temperature difference as in elements with linear characteristic. Thus variation of temperature at the cold end has less effect. Such elements with curved characteristic are specially suitable for the formation of multiple thermoelements because when the cold ends may have a temperature between 100 and 200° C. considerably smaller lengths of wire are enough. J. J. S.

4765. Temperature Variation of the Thermoelectric Properties and the Specific Heat of Nickel-Chromium Alloys. A. W. Foster. *Phil. Mag.* 18. *pp.* 470–488, *Sept.*, 1934.—Accurate measurements of the thermoelectric power of nickel and two of its alloys with 1 and 2 % of chromium have shown that these alloys show only 30 % and 10 % respectively of the change in the Thomson coefficient at the Curie point found in nickel. A method for the measurement of the specific heats of metals in wire form has been developed and applied to the present problem. In it the inaccuracy of using the irregularly varying resistance of the metal wire to measure its temperature has been overcome. The two alloys show respectively 55 % and 30 % of the drop in the specific heat at the Curie point measured in nickel. AUTHOR.

4766. Thermal Agitation Voltages in Resistors. C. Neitzert. *Physics*, 5. *pp.* 292–296, *Oct.*, 1934.—The limited range of previous measurements of thermal agitation voltage is pointed out and data are given which extend the range of resistances and frequencies considerably. The results substantiate Nyquist's theory for resistances up to $1{\cdot}7 \times 10^9$ ohms and for frequencies between 1 and 10,000 cycles per second. A value of $1{\cdot}366 \times 10^{-16}$ erg per degree with a probable error of $0{\cdot}016 \times 10^{-16}$ erg per degree is obtained for Boltzmann's constant. This is nearer to the accepted value than previous determinations by this method have given. AUTHOR.

See also Abstract 4716.